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25 MAY 1977

IMPLEMENTATION OF RISK ASSESSMENT IN THE TOTAL RISK ASSESSING COST ESTIMATE (TRACE)

BY

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SIGNAL CORPS

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US ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013

USAWC MILITARY STUDIES PROGRAM PAPER

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IMPLEMENTATION OF RISK ASSESSMENT IN THE TOTAL RISK ASSESSING COST ESTIMATE (TRACE)

AN INDIVIDUAL STUDY PROJECT

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The concept of the Total Risk Assessing Cost Estimate (TRACE) was articulated by the ASA(R&D) on 12 July 1974. It is a means of explicitly accommodating the unforseen and unidentifiable costs which characterize research and development projects. The TRACE is required to possess the property that it is an estimate of the 50th percentile of the project cost probability distribution. Unfortunately, early attempts to

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implement the TRACE met with limited success. A formalized study was undertaken to develop adequate techniques and two candidate methodologies emerged. One of the approaches, the TRACE Network Model, is extremely promising. The second technique, TRACE Risk Tabulation, can be improved upon by a modification involving computer generation of the imbedded probability distribution. There remain some problems in "educating" users of the value of the TRACE, and the TRACE concept suffers from some inherent shortcomings. It is recommended that the new techniques for developing the TRACE be implemented, along with some ancillary actions to support the implementation and enhance the usefulness of the TRACE.

ABSTRACT

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The concept of the Total Risk Assessing Cost Estimate (TRACE) was articulated by the ASA(R&D) on 12 July 1974. It is a means of explicitly accommodating the unforseen and unidentifiable costs which characterize research and development projects. The TRACE is required to possess the property that it is an estimate of the 50th percentile of the project cost probability distribution. Unfortunately, early attempts to implement the TRACE met with limited success. A formalized study was undertaken to develop adequate techniques and two candidate methodologies emerged. One of the approaches, the TRACE Network Model, is extremely promising. The second technique, TRACE Risk Tabulation, can be improved upon by a modification involving computer generation of the imbedded probability distribution. There remain some problems in "educating" users of the value of the TRACE, and the TRACE concept suffers from some inherent shortcomings. It is recommended that the new techniques for developing the TRACE be implemented, along with some ancillary actions to support the implementation and enhance the usefulness of the TRACE.

PREFACE

This Individual Study Project was undertaken as a part of the US Army War College Military Studies Program for Academic Year 1977. The study responds to a topic suggestion by the Deputy Chief of Staff for Research, Development and Acquisition (DCSRDA), Headquarters Department of the Army. The author's choice of this topic was based upon experience with the problem at the Project Management Level combined with a continuing interest in improving the tools available to the Army for management of Research and Development projects.

During the research for this study, the author was privileged to secure the cooperation of individuals from 10 Project Management Offices (including 6 Project Managers), appropriate functional staff offices of three Major Subordinate Commands of the US Army Development and Readiness Command (DARCOM), as well as numerous personnel in [illegible], DARCOM, within the ODCSRDA, other DA Staff Agencies, and the Army Secretariat. The reader will find, however, no reference to specific individuals, as the information given was supplied on a non-attribution basis to encourage frank and forthright disclosure. Every effort has been made to insure honest and balanced presentation of the information collected.

The author wishes to express his appreciation to the aforementioned personnel for their splendid cooperation; to [illegible] John Blanchard, [illegible], DARCOM, and to LTC Duane Riggs, [illegible], for their in-process review of the paper; to his study advisor, Col Robert T Reed, and to the other faculty members and fellow students who provided many constructive suggestions; and to the [illegible] System Development [illegible] for their outstanding support.

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IMPLEMENTATION OF RISK ASSESSMENT IN THE TOTAL RISK ASSESSING COST ESTIMATE (TRACE)

CHAPTER I

INTRODUCTION

Prior to developing techniques for implementing Risk Assessment, it is necessary to introduce some general concepts and definitions which will serve as the basis for detailed discussion. This chapter provides that background and introduces the problem.

THE CONCEPT OF THE TOTAL RISK ASSESSING COST ESTIMATE (TRACE)

It is relatively common knowledge that a serious problem in defense development programs is cost overruns and schedule slippage. Very few programs are completed within initial estimates of cost or within the time period initially projected for the development. Cost overruns of 50 or 100 per cent are not uncommon, as can readily be determined by perusal of newspapers or news magazines on an almost random basis. These overruns, in addition to creating adverse publicity and embarrassment, present a substantive problem -- to [illegible] [illegible] one project "grows", the funds to continue [illegible] project [illegible] come from deletion or deferral of

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other projects of lesser priority. The net result is that the Army gets fewer of the systems on which plans were based, money spent on deleted systems is wasted, and deferral of other systems generally induces cost growth in those systems, thus creating a "snowball" effect.

On 12 July 1974, Mr. Norman Augustine, then Assistant Secretary of the Army for Research and Development, in a memorandum to the Director of the Army Staff (Annex A), directed that henceforth the concept of the TRACE would be used in Army Research and Development (R&D) Programs. The basic philosophy of the TRACE is as follows: Inherent in any R&D program is a factor of risk. Since R&D implies a foray into the unknown, it cannot be expected that every activity will occur according to plan. There will be blind alleys, unforseen complications, and similar mishappenings. It is therefore unrealistic to allocate to a project only those resources which correspond exactly with the project plan. Additional funds must be programmed as a margin against those unforseen and unidentifiable problems which characterize R&D projects.

The TRACE concept can be readily displayed in graphic form as shown in figure 1.

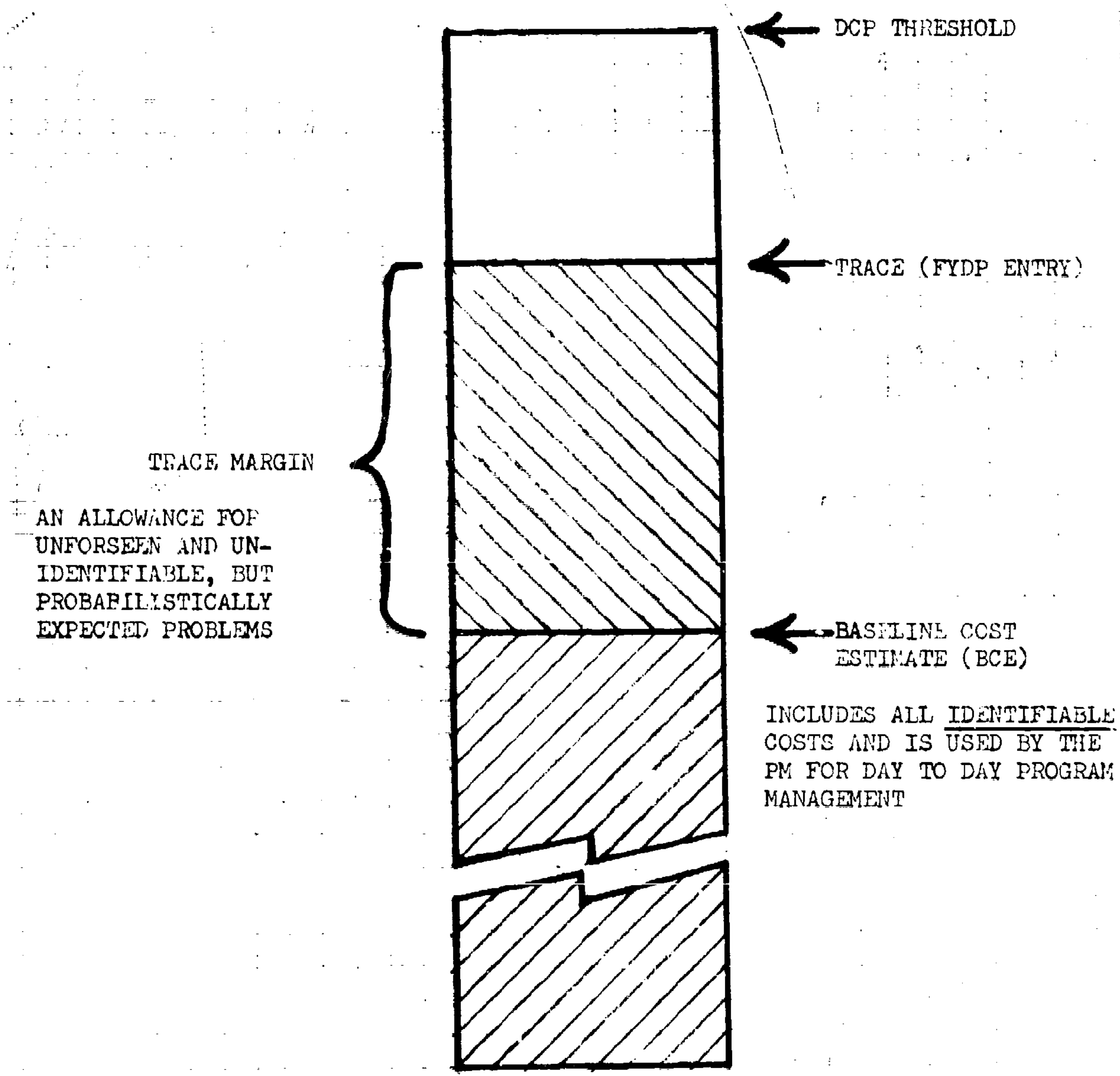
DCP THRESHOLD
TRACE (FYDP ENTRY)
TRACE MARGIN
AN ALLOWANCE FOR UNFORSEEN AND UN-IDENTIFIABLE, BUT PROBABILISTICALLY EXPECTED PROBLEMS
BASELINE COST ESTIMATE (BCE)
INCLUDES ALL IDENTIFIABLE COSTS AND IS USED BY THE PM FOR DAY TO DAY PROGRAM MANAGEMENT

FIGURE 1

It should be noted that the Project Manager (PM) continues to use only the planned activities (Baseline Cost Estimate or BCE) as the project target cost, while the TRACE Margin is held at Department of the Army (DA) level in the Office of the Deputy Chief of Staff for Research, Development and Acquisition (DCSRDA) for release to the PM upon application and justification. However, the TRACE value is used for programming and budget purposes, and the cost entry in the Five Year Defense Program (FYDP) is the TRACE. Thus, the Army has fewer, but more realistically funded projects in the FYDP. After TRACE funds are exhausted, should that occur, the project may be continued through reprogramming,if desired, but is subject to challenge by higher authority to include action by the Defense Selected Acquisition Review Council (DSARC), should it appear that the Decision Coordinating Paper (DCP) threshold will be breached.

PROJECT COSTS AS PROBABILISTIC ENTITIES

To put the TRACE concept into a broader perspective, it is useful to introduce a probabilistic view of project costs. This view uses the notion that project costs follow a probability distribution such as figure 2.

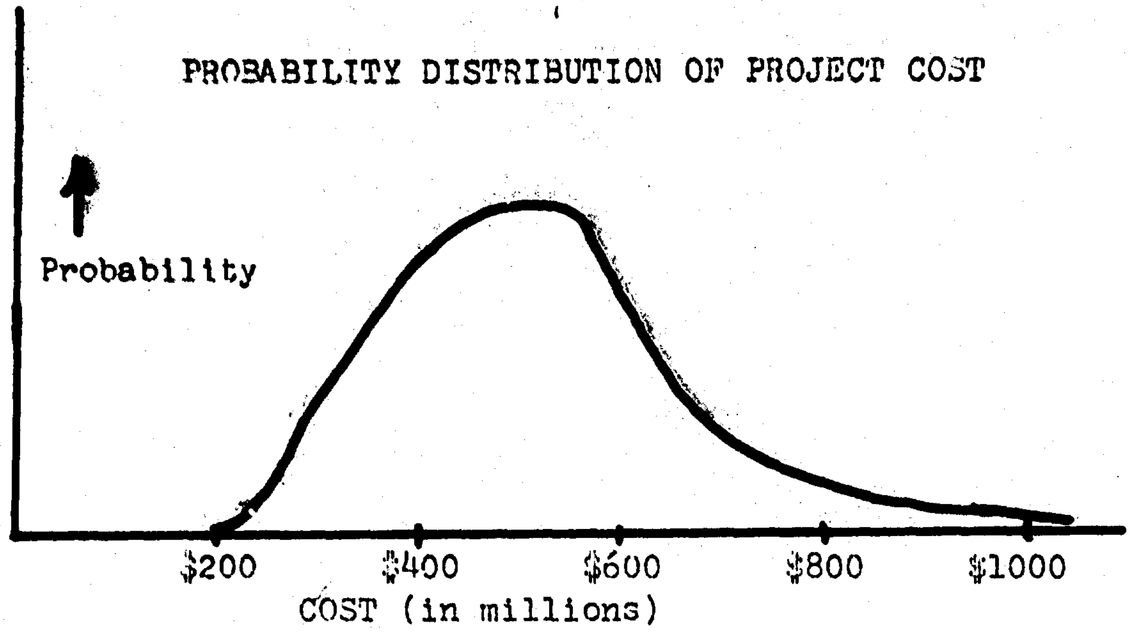

Figure 2

The probability distribution is interpreted by determining the area under the curve for any cost range of interest. For example, the probability that the project will cost less than a given amount is the area under the curve between zero and the given amount. Figure 3 illustrates this for $400 million.

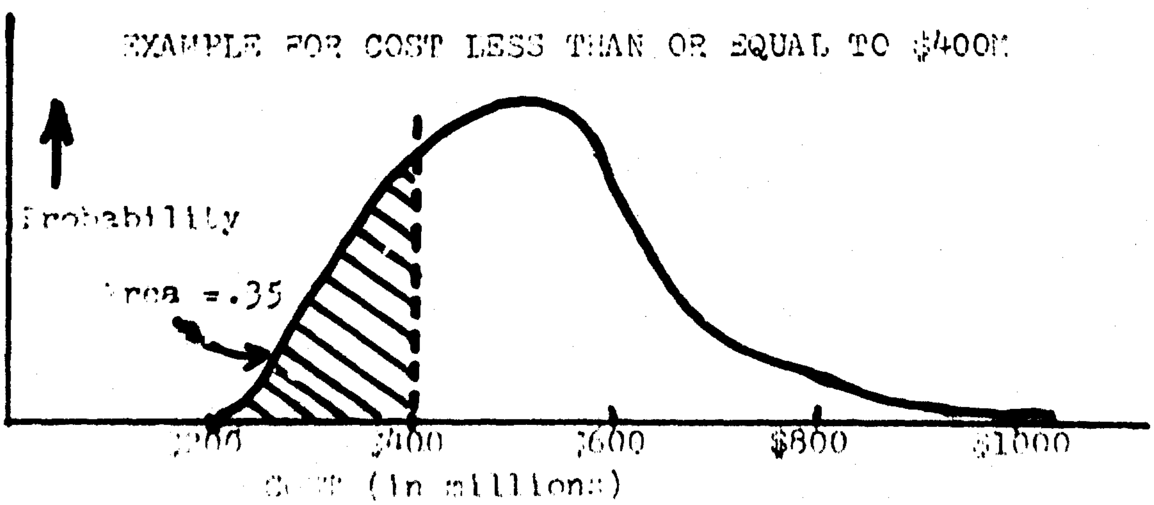

Figure 3

Since the shaded area in figure 3 is 0.35, it is determined that the probability of a project cost less than or equal to $400 million is 0.35. By convention, $400 million is called the 35th percentile of the distribution.

Similarly, the probability that a project will incur a cost greater than a given amount is found from the area under the curve to the right of the given amount. Figure 4 illustrates this for $600 million.

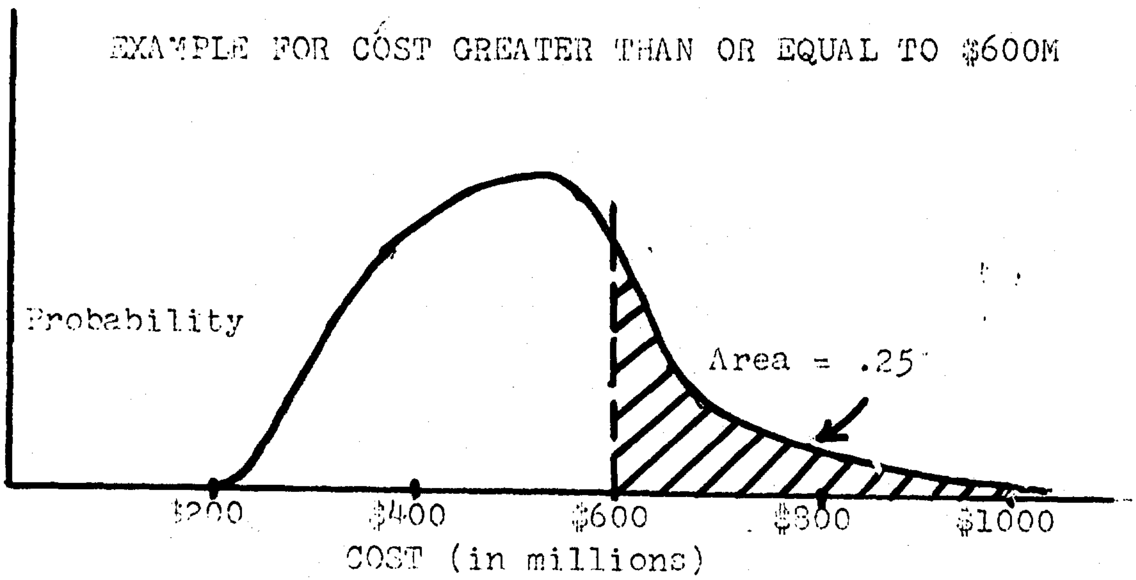

Figure 4

[illegible] the probability of cost equal to or greater than $600 million is 0.25.

Finally, figure 5 illustrates determination of the probability of cost within a specified range.

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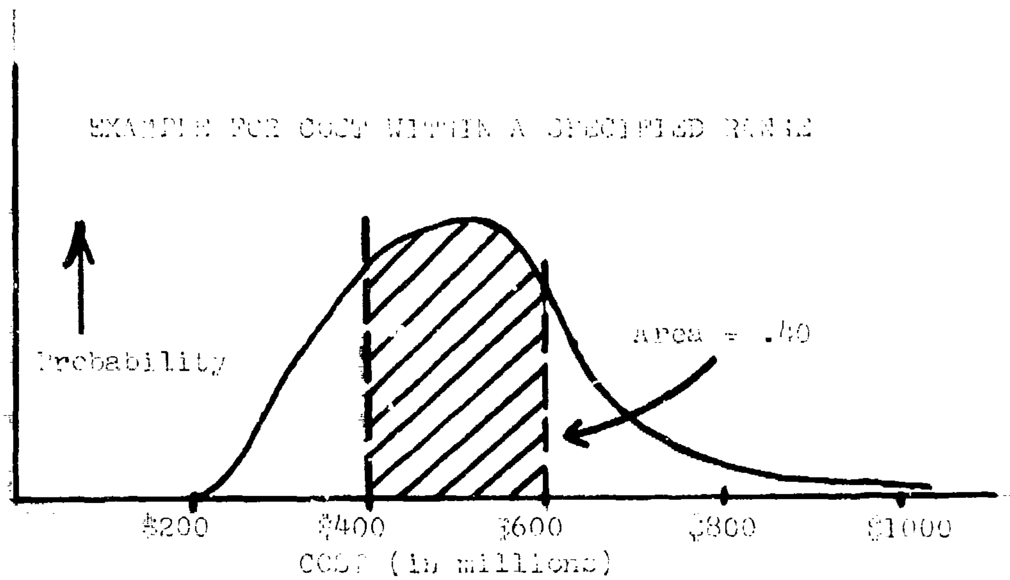

Figure 5

Here it has been found that the probability of project cost falling between $400 and $600 million is 0.40.

The foregoing, of course, is strictly theory. In practice, one does not have the probability distribution of project costs. At best, he may have an estimated or assumed distribution, but more typically he has even less information. Nonetheless, the probabilistic approach represents a convenient and meaningful basis for discussion, and a point of departure from which to gain some understanding of the real world situation.

THE TRACE IN THE PROBABILISTIC FRAMEWORK

Mr. Augustine, in his 12 July 1974 memorandum, actually used the probabilistic framework to define

the TRACE. Basically, he stated that the TRACE should be developed so as to represent the median, or 50th percentile of the cost probability distribution of a project. Figure 6 illustrates this concept.

PROBABILISTIC VIEW OF THE TRACE

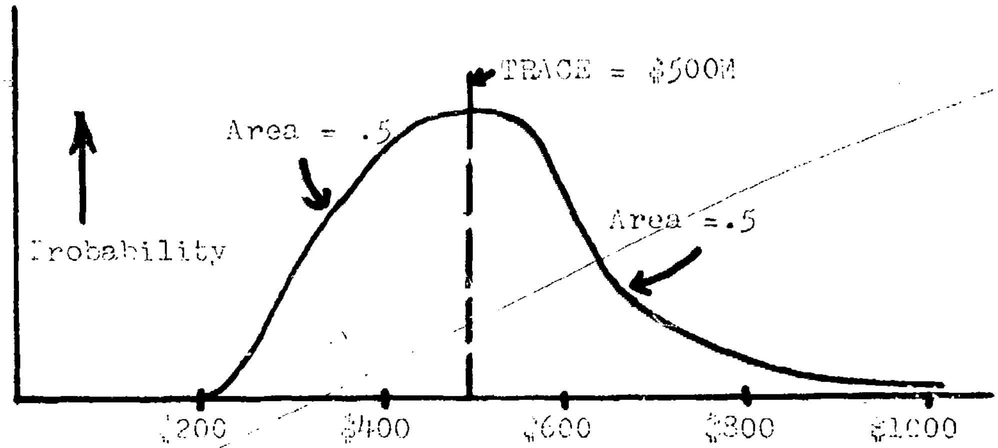

Figure 6

Thus there is a 50 per cent chance that the project will cost less than the TRACE (underrun) and likewise a 50 per cent chance that it will cost more (overrun). Mr. Augustine did not provide a rationale for selecting the median as the TRACE, but a reasonable rationale may be deduced as follows: The basic goal of the TRACE is to minimize the requirement to cancel or defer on-going or planned projects in oreder to fund overruns in other projects. By choosing the TRACE at the median cost

for each project, we achieve a solution where in the long run, about half the projects will overrun, while half will underrun. Overall, the money 'released' by the underruns should cover the cost of the overruns, and the necessity to disturb the programmed funds should be avoided.

If viewed in the short run, this rationale has some defects. Most significant is that in any given year, one may find that the overruns are all in the larger projects, while the underruns are in the smaller projects, resulting in a net shortage of funds. Obviously, the reverse could just as easily occur, with a resultant excess of funds on hand. If the state of the art of cost estimation permitted, one could actually adjust the TRACE percentiles (i.e., make the TRACE percentiles different from the median) on a project by project basis so that there would be a high probability of offsetting underruns and overruns. However, the state of the art of cost estimation does not support so ambitious an approach, and implementation of the median approach provides adequate challenge, as well as offering significant, if not ultimate improvement in reducing resource programming turbulence.

TRACE DEFINITION

Unfortunately, in day to day use at various offices, the TRACE has acquired a large number of definitions and interpretations. For purposes of insuring clarity and understanding in this paper, and as a proposal for an overall definition to improve communication throughout the Army, the following definition of the TRACE is given:

"The Total Risk Assessing Cost Estimate (TRACE) is a point estimate, given in dollars, of the cost of a research and development project. The estimate is chosen such that the probaility that it will be exceeded is 0.50. For control purposes the TRACE is normally divided into two parts -- the Baseline Cost Estimate (BCE), which includes both known and anticipated costs, and the TRACE Margin, which is a provision for the unknown and unidentified costs. The TRACE (and its components) may address the overall project cost, or the cost for a given Fiscal Year. If not clear from context, this distinction should be made explicit by identification, such as 'the FY80 TRACE' to indicate only one year, or 'the project TRACE' to indicate overall project cost."

STATEMENT OF THE PROBLEM

The problem to be addressed in this paper is simply stated in the form of the question " How can the Army develop estimates of the cost of R&D projects which satisfy the requirements of the TRACE?"

CHAPTER II

CURRENT AND PREVIOUS TECHNIQUES

The problem is hardly new. There has been a continuing effort at all levels of management, both in industry and in government to improve the accuracy and realism of cost estimates over the years, and in fact, cost estimating techniques have improved. Unfortunately, the availability of resources (in real terms) has concurrently decreased, and the options for commitment of those resources have become more expensive. In short, the criticality of having a good cost estimate has outpaced the improvement in cost estimating techniques. Thus the challenge is to provide a cost estimating improvement which closes the gap. This chapter will discuss the approaches currently and previously used, and assess their success or lack thereof.

EXCURSIONS FROM THE BASELINE COST ESTIMATE

A number of techniques tried to improve the realism of cost estimates revolve around the use of the BCE as a point of departure and then developing an increment to cover potential cost growth. This is basically an attempt to develop the TRACE Margin as an isolated entity. Two

basically different subapproaches have been used.

Historically Based Excursions

One implementation of this technique was suggested by Mr. Augustine in his 12 July 1974 memorandum. It is commonly referred to as the "K" factor approach, although the derisive term "fudge factor" has also been applied. There are many variations, but a simple example will serve to demonstrate the technique.

Suppose the BCE for a new tank includes three major categories; automotive, armament, and fire control. From a review of past tank developments, the analyst determines that cost growth in those three categories has averaged 30 per cent, 40 percent, and 60 per cent, respectively. The current estimates in the three categories are then increased by the corresponding percentages. In practice, of course, considerably more detailed procedures are used, to include a lower level of detail, use of statistical procedures to validate the results, and integrating schedule considerations into the procedure to allow programming by Fiscal Year.[1]

These procedures suffer from a number of defects. First, the use of the BCE as a starting point introduces bias into the procedure right from the start. Second, the

extrapolation of growth factors from past developments is in itself a risky procedure[2], and third, the cost/schedule relationships are not sufficiently well defined to facilitate proper programming.

Currently Based Excursions

The other general "excursion" technique, rather than extrapolating from past developments, attempts to use the current situation as the basis for estimating cost growth. Typically, Delphi[3] techniques are used to accomplish this task. The Delphi technique uses a poll of qualified experts to arrive at a consensus estimate. This approach can work well, but is very difficult to administer, and its validity is very sensitive to the proper structure of the poll, the expertise of the various experts polled, and the procedure used to reconcile variances among respondents. No case was found in the sample of projects used for this research where Delphi had been properly applied.

INDEPENDENT PARAMETRIC COST ESTIMATES

The use of Independent Parametric Cost Estimates (IPCE) to improve cost estimates is a well established procedure, and is required by regulation[4] in major programs. Unfortunately, in most cases, parametric

procedures are not sufficiently accurate nor do they provide adequate cost/schedule integration to serve as a basis for resource programming. They are, however, extremely valuable as a "cross check" and are regularly used to validate that a BCE is at least a "ballpark" figure. A wide variance between the BCE and IPCE is normally sufficient cause to require a re-evaluation of both estimates and a reconciliation of differences prior to proceeding. This use of the IPCE militates strongly against its use as an input to the TRACE. Should the IPCE be used in some way to develop the TRACE, or vice versa, the requisite independence of the IPCE will have been lost, and it will not be an effective "cross check" mechanism.

A final argument against using IPCE for the TRACE concerns the decreasing usefulness of parametric estimate with time. Typically, parametric estimates are most valuable when a project is in its embryonic stages, and the only well defined quantities are,,in fact, the desired parameters of the product. However, as project definition proceeds, and design becomes firmer, manufacturing techniques proven,etc., engineering type estimates become more accurate and supercede the parametric estimates[5]. Ideally, the technique used to generate the TRACE should be viable throughout the project life.

MANAGEMENT RESERVE AND RELATED TECHNIQUES

Historically, Project Managers have attempted to maintain a management reserve. Since management reserves are not generally authorized in the current environment, the PM endeavors to "bury" a de facto management reserve in one or more of the project activities. While this management reserve can be used to fund risk created set-backs, it can also be used to fund management errors and the like. Needless to say, while the Congress and the DOD may be willing to fund contingencies arising from the inherent project risk, they are quite unwilling to underwrite management mistakes. Thus the management reserve is not a suitable substitute for the TRACE Margin. Further, since management reserves are covertly included in the program, they are not based on a well defined estimating procedure, but are "seat of the pants" estimates made by the PM. These estimates are often referred to as "modified Delphi" -- inasmuch as they reflect the opinion of one "expert", the PM. The current climate within the DOD and particularly within the Army indicates that it will be increasingly difficult to arrange for a management reserve at the PM level. It appears that the PM will be well served in the future to develop a well supported TRACE Margin. It will be his only source of contingency funds.

CHAPTER II

FOOTNOTES

1. For an example of a more detailed approach see Letter, HQ,DA DAMA-PPM-P, subject: <u>Letter of Instruction (LOI) for Implementation of RDTE Cost Realism for Current and Future Development Programs</u>, dated 6 March 1975.

2. Bernard Ostle, <u>Statistics in Research</u>, pp.170-174.

3. H.W. Lanford, <u>Technological Forecasting Methodologies; A Synthesis</u>, pp. 20-23.

4. US Department of the Army, <u>Army Regulation 11-18</u>, paragraph 2-3a, p. 2-6.

5. J.E. Holeman, Jr., <u>A Product Improved Method for Developing a Program Management Office Estimated Cost at Completion</u>, pp. 2-3.

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CHAPTER III

EVOLVING TECHNIQUES

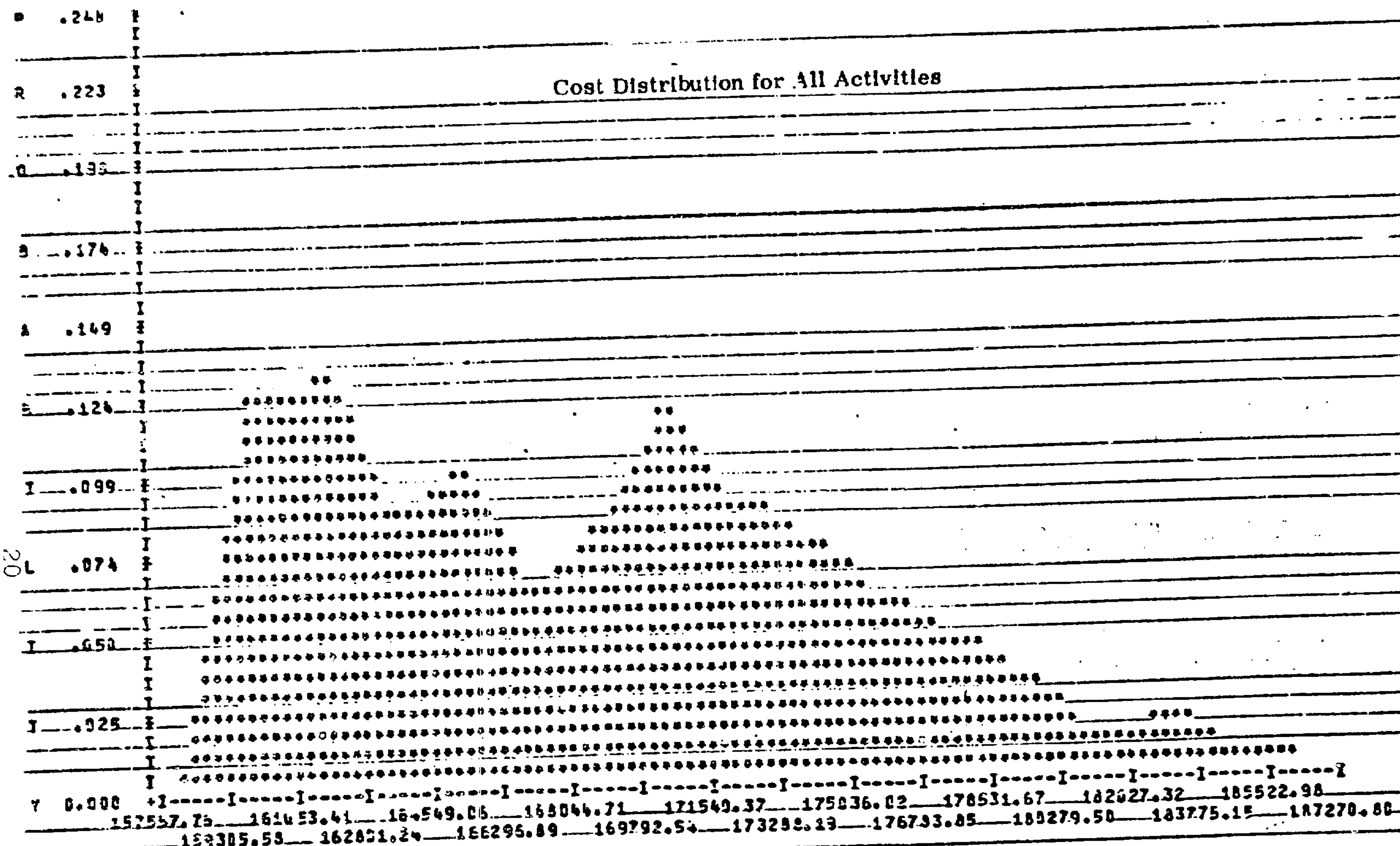
As a result of Mr. Augustine's memorandum and a subsequent DCSRDA Letter of Instruction (LOI)[6], a number of techniques have been tried. The technique suggested in the DCSRDA LOI was generally found to be unworkable, as it was too general in nature and unfortunately, was also mathematically incorrect. PM Roland, through a contract with John M. Cockerham & Associates, Inc., developed a procedure which worked well for Project Roland. The contractor subsequently submitted an unsolicited proposal to document and generalize the procedure for use in a broader range of applications. This proposal was accepted and resulted in Technical Report RC-77-3, entitled _US Army Total Risk Assessing Cost Estimate (TRACE) Guidelines_.[7] This chapter consists of a short description of each of the two alternative techniques proposed in the report, along with a discussion of each.

TRACE NETWORK MODELING - DESCRIPTION

TRACE Network Modeling is named as the "preferred" methodology in the Cockerham report. It uses a _Monte Carlo_[8] simulation of the project activities to aggregate the overall effect of sub-estimates derived for each

activity. The technique is to break down the project into discrete activities which can be graphically arranged in a network to show their dependencies and interrelationships (e.g., testing cannot start until each of two competing prototypes are delivered, the test plan is approved, the range schedule is approved, and the instrumentation has been secured and calibrated). For each activity, an estimate is developed of three quantities -- the probability distribution of the fixed costs associated with the activity (e.g., the cost of test equipment), the probability distribution of the time required for the activity, and the probability distribution of the variable cost (cost per unit time) of the activity. The model is then "run" a large number of times, with a statistically valid value chosen at "random" from the appropriate probability distributions each time. Each "run" of the model is then one possible outcome for the project. All of the "runs" then constitute a large sample from which the overall project probability distribution can be estimated. Figure 7 is such an estimate, and is analogous to the probability distributions discussed in Chapter I. Since direct measurement of the area under the "curve" in Figure 7 would be difficult, the output shown in Figure 8 is also provided. It is simply the integral of Figure 7, so that

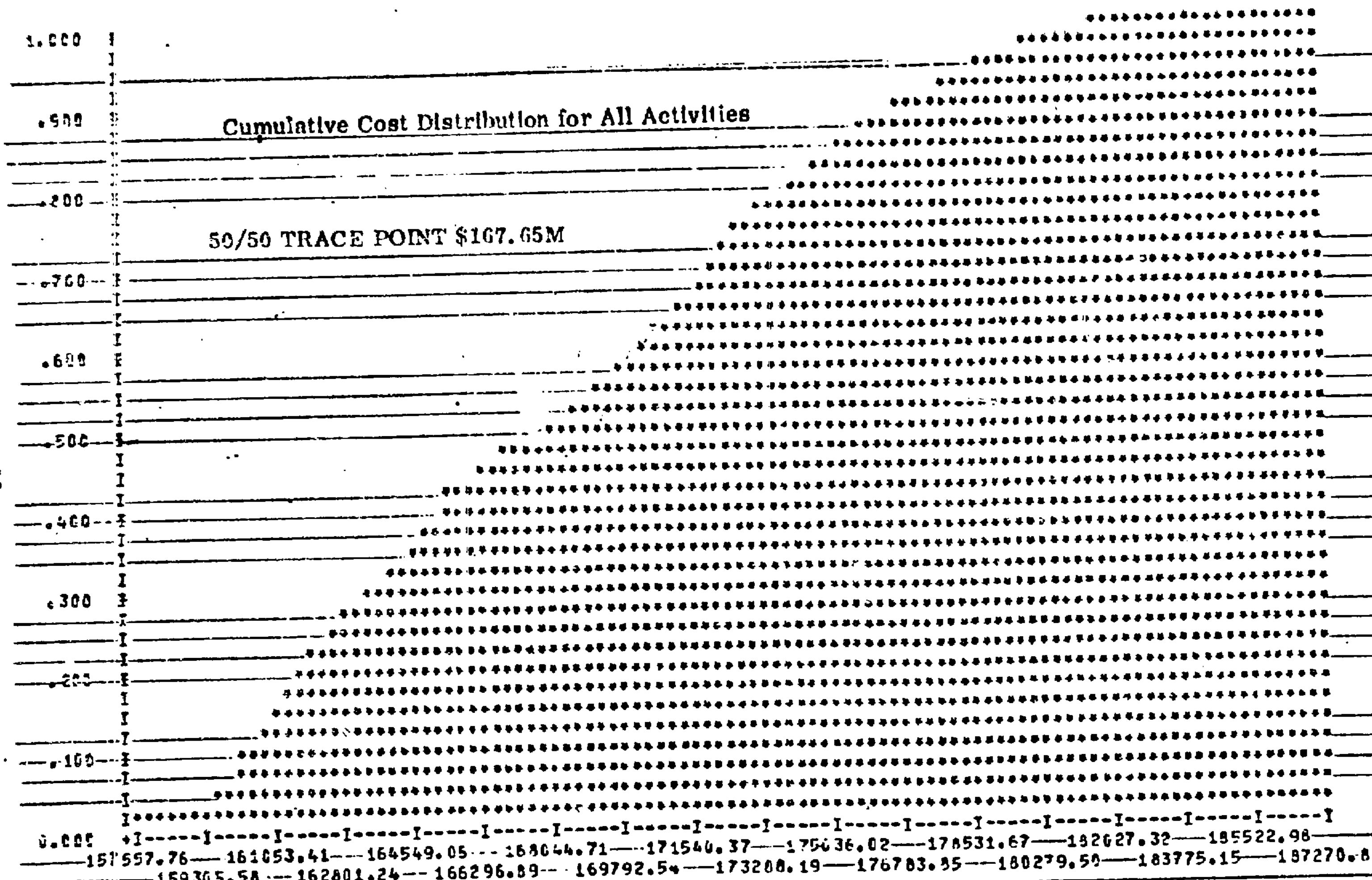
Cost Distribution for All Activities



TRACE RISK NETWORK

COST DISTRIBUTION FOR TERMINAL NODE 90
MEAN = 165653.58 STANDARD DEVIATION = 6486.55

FIGURE 7



TRACE RISK NETWORK

COST-DISTRIBUTION-FOR-TERMINAL-NODE—90
MEAN = 168650.95 STANDARD-DEVIATION = 6486.55

the area to the left of any point can be read directly from the ordinate on Figure 8. For example, to find the TRACE point, simply enter Figure 8 at the 0.5 ordinate and read the corresponding abscissa ($167.65M).

Another feature of the network model[9] used by Cockerham & Associates is the ability to select outputs for a given Fiscal Year. Figures 9 and 10 show the two types of outputs for a given FY, and are most useful for assisting in making programming decisions.

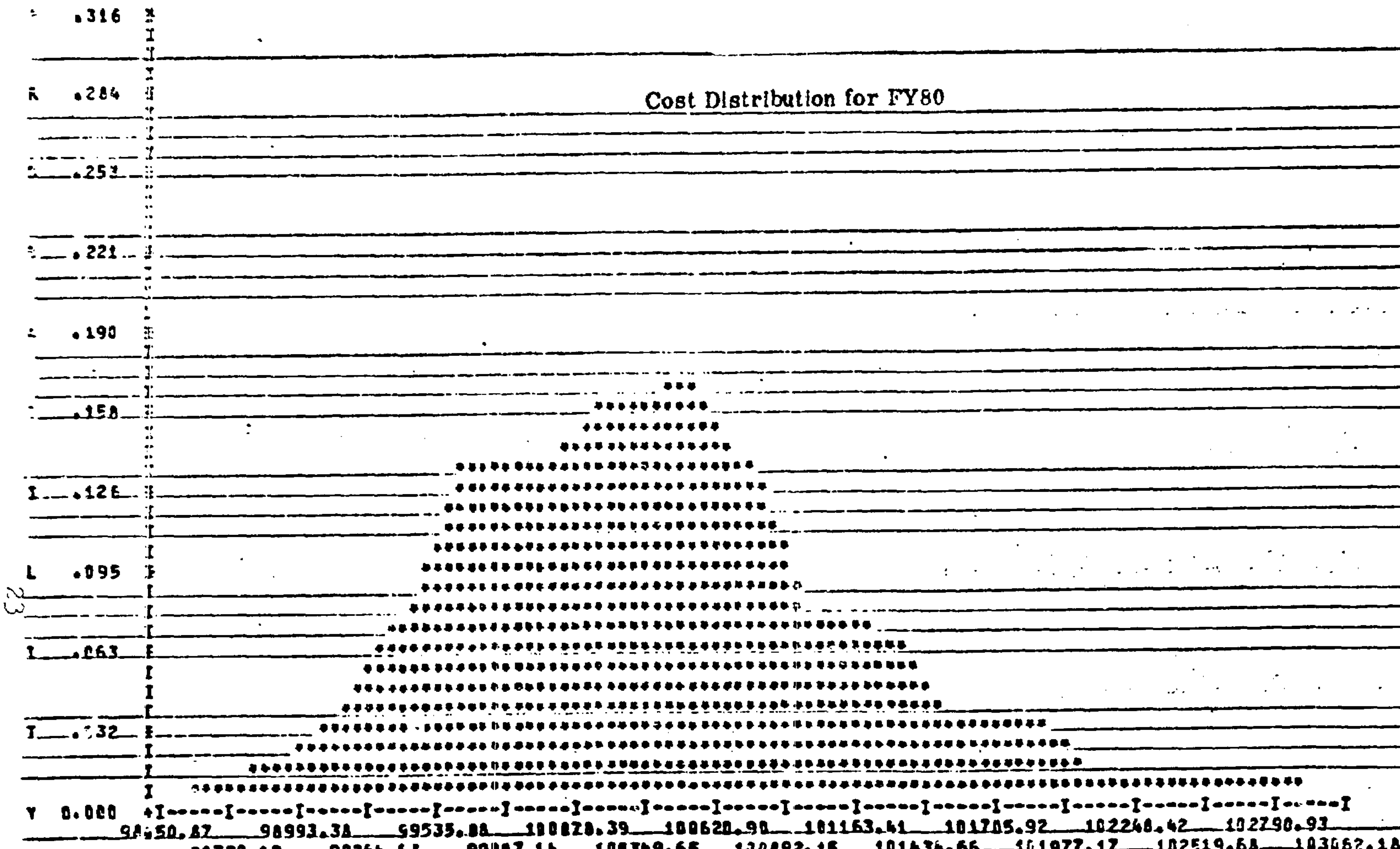
TRACE NETWORK MODELING - DISCUSSION

The ensuing discussion of the TRACE Network Modeling technique is organized into three subsections - - advantages, disadvantages, and an overall evaluation.

Advantages

The requirement to break the project down into discrete activities forces a disciplined approach and allows the person(s) developing the various subestimates to work on a clearly defineable entity. Since the network model accounts for many of the interdependencies between activities, the analyst can generally concentrate on the activity itself. Further, an estimating error in any one activity will have little effect on the overall result, and (hopefully), any estimating errors which are biased

Cost Distribution for FY80



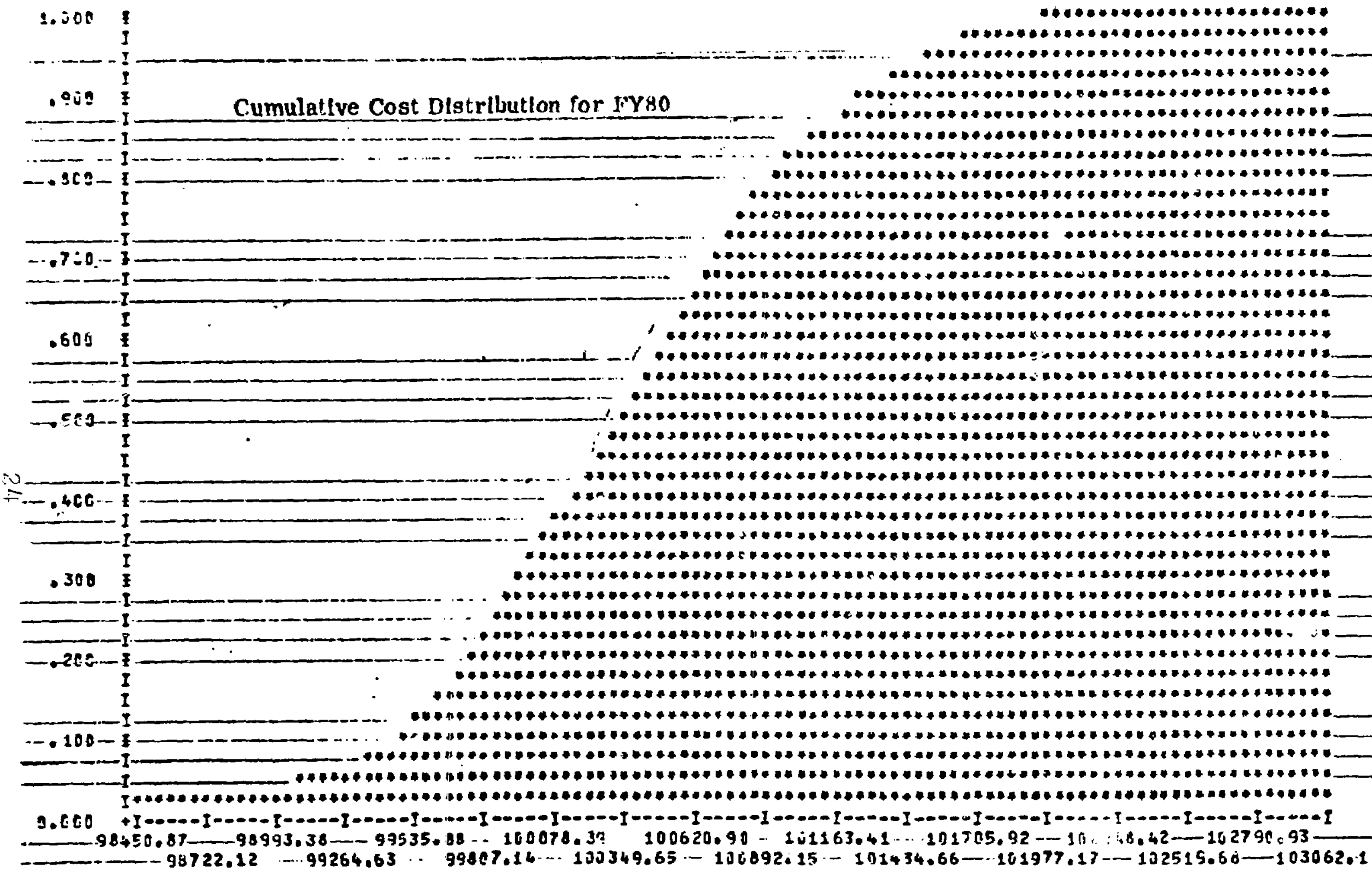
TRACE RISK NETWORK

COST PRINTOUT FOR TIME = 12.00
MEAN = 100443.51 STANDARD DEVIATION = 713.57

PROBABILITY OF COST OVER-RUN AT TIME = 12.00 IS 1.00 AVERAGE OVER-RUN IS 2263.51

FIGURE 9

Cumulative Cost Distribution for FY80



TRACE RISK NETWORK

COST-PRINTOUT FOR-TIME-=——12.00
MEAN =——100443.51——STANDARD-DEVIATION-=——713.57

PROBABILITY-OF-COST-OVER-RUN-AT-TIME-=——12.00—IS-1.00——AVERAGE-OVER-RUN-IS——2743.51

on the low side will be offset by other estimates whi   1
contain a high side bias.

The network model integrates cost and schedule as an inherent feature of its function. The Fiscal Year output feature provides valuable programming information.

The output format (probability distribution) is extremely useful, and provides information not available from any other technique. Of particular value are the percentile estimates, the estimated variance, and the range of cost and schedule.

Once the model is developed, it can be readily modified and re-run to incorporate later information. For example, once the design phase is complete, the actual costs and schedule for the design phase can be inserted into the model, thus reducing the variance and sharpening the value of the estimate for the remainder of the project.

The model outputs provide a valuable framework for project monitorship. When the actual experiences of the real world deviate significantly from those indicated by the simulation, the PM can investigate to determine whether the problem is lack of realism in the model or a real world management problem. In either case, the PM can proceed on the basis of better information than he previously had.

The use of probability distributions rather than point estimates is a realistic representation of the real world. The normal probabilistic variations of real life are replicated in the model.

The model does not depend directly on the BCE as a point of departure. To the degree that inputs are developed independently of the BCE, the model results are free of any bias in the BCE.

Disadvantages

The usefulness of the output provides to the average user a feeling of accuracy and reliability not fully justified by the modeling process. The user is likely to forget that he is still dealing with an estimate.

The process of developing and running the model is expensive. It requires a competent analyst to properly develop the model and secure reliable estimates.

The model is basically just a technique for aggregating the activity estimates. It does not compensate for bad inputs -- the estimating problem has simply been "passed down" to the activity level. There is nothing in the procedure to assist in getting good activity estimates. In fact, the form of the required estimates (probability distributions) represents an unusual approach to most engineers and could lead to inadvertent errors.

Although the model takes into account most activity interdependencies, it cannot generally account for induced changes to follow on activities. For example, if the cost of activity 3 is dependent on the cost of activity 2, the model will nonetheless treat the two activity costs as independent. Special treatment by the analyst who develops the model may overcome some of these problems if the nature of the dependency is amenable to accomodation by the model.

Despite the complexity of the model, it still represents a considerable simplification of the real world. This simplification is achieved through various assumptions either explicit or implicit in the model. To the degree that these assumptions are not understood, not recognized, or not accounted for in interpretation of results, the model output may be misleading and inaccurate.

There is no simple technique for performing sensitivity analyses. Excursions form the baseline input require a complete rerun of the simulation.

Overall Evaluation

Of all the techniques currently in use, the TRACE Network Modeling Technique is by far the most comprehensive, and offers the most useful output, both in

terms of TRACE application, flexibility, and ancillary uses of output (such as for project monitorship). The Network Modeling Technique further has the potential to improve to the degree that network modeling and methods for developing better estimates of activity cost and schedules improve. Thus, where the project cost justifies the initial high cost of developing the TRACE Network Model, and where appropriate analytic and computer support is available, the Network Model offers the best approach to TRACE development.

TRACE RISK TABULATION - DESCRIPTION

The Cockerham report takes note that in some cases the Network Modeling Technique may be inappropriate. The TRACE Risk Tabulation technique is offered as an approach to be used in such cases. It may be characterized as an expected value simulation of the project, and like the network approach offers only an improved means of aggregating a number of sub-estimates, with no suggestion as to how those critical sub-estimates might be sharpened. The technique is best explained by reference to the tabulation (Figure 11, which is the example used in the Cockerham report). Step 1 involves reducing the project into elements suitable for analysis. The report suggests that a combination of Work Breakdown Structure (WBS)

PROJECT Y
WEAPON SYSTEM RISK ASSESSMENT

Program Elements 1	Prob. of Occurrence P(A) 2	Cost Impact to Element/ Milestone TYPE A 3	Prob. of Occurrence P(B|A) 4	Prob. of Occurrence P(B) 5	Cost/Schedule Impact to Other Program Elements TYPE B 6	Date of Impact Calendar Date 7	Date of Impact FY 8	Expected Loss 9	Adjusted Expected Loss 10
Vehicle									
1. Armor	.20	$3.0M	-	-	-	4/78	78	$ .6M	$ .8M
2. Suspension	.60	$ .4M	1.0	.60	$1M, 2MN*	6/78	78	$ .84M	$1.12M
3. Tracks	.25	$ .8M	-	-	-	6/78	78	$ .2M	$ .27M
4. Power Train	.60	$1.5M	.75	.45	$4M, 2MN*	9/78	78	$2.7M	$3.6M
5. Engine	.20	$ .5M	1.0	.20	$ .5M, .1MN, Engine Qualification	9/78	78	$ .2M	$ .27M
6. Integration	.75	$ .2M	1.0	.75	$2M, 2MN*	11/78	79	$1.65M	$2.2M
Program Milestones									
7. Initiate Acceptance Testing	.70	0.0	1.0	.70	$6M, 3MN*	2/79	79	$4.2M	$5.6M
8. OSD Review	.60	0.0	1.0	.60	$2.5M, 1MN*	7/79	79	$1.5M	$2M
9. DSARC	.30	0.0	1.0	.30	$4M, 2MN*	10/79	80	$1.2M	$1.6M
						Totals		$13.09M	$17.46M

*Total Program Schedule Slips

FIGURE 11

elements and critical milestones are best suited for the Risk Tabulation Model. The first column in figure 11 shows the results of step 1 for the example problem. Columns 2 and 3 are completed by securing (by Delphi techniques, presumably) the point probability and cost impact of likely overruns to the program element line. These are called Type A impacts and may be interpreted as follows: (line 1) "There is a 0.2 probability that the armor element will experience a cost overrun. If the overrun does occur, the cost of the armor will most likely be increased by $3.0 million."

Columns 4,5,6 provide for interdependencies (Type B impacts). For example, on line 4, the column 4 entry of .75 means that _if_ we do have problems with the power train, there is a .75 probability that other program elements will also be affected, and if they are, the overrun will be $4.0 million with a two month schedule slip (col.6). The column 5 entry represents the overall probability that the column 6 impact will occur, and is computed as the product of the Type A and Type B probabilities (.60 times .75).

Columns 7 and 8 indicate the date and Fiscal Year of impact, to allow proper programming of TRACE Margin Funds. Column 9 is the expected value,defined as the probability of impact times the cost of impact. For line

4 the computation is .6 times $1.5 million plus .45 times $4 million = $2.7 million.

Column 10 is an adjustment to the expected value of impact. This adjustment attempts to take into account the fact that <u>if</u> an impact does occur, it will cost the full impact value - <u>not</u> the expected value. Thus if the TRACE Margin were set at only the expected value of the impact, it is likely that the TRACE Margin would be inadequate. The contractor provides an heuristic for making this adjustment. The rule is that any impact with overall probability greater than .75 will be fully funded, and those with lesser probabilities will use an adjusted expected value. For example, line 6, column 10 shows $2.2 million ($0.2 from col. 3 plus $2.0 from col.6). Since the probabilities are greater than (or equal to) 0.75, full funding has been used. Line 4 provides an example of the adjustment procedure when the probabilities are less than .75. Here the given probabilities are divided by .75 and the expected value is recomputed as (.6/.75) times $1.5 plus (.45/.75) times $4 = $3.6. This adjusted value is justified on the basis of intuitive feeling and "reasonableness".

<u>TRACE RISK TABULATION - DISCUSSION</u>

As for the Network Modeling portion, this discussion

is organized into a listing of advantages, disadvantages and an overall evaluation.

Advantages

The technique is relatively inexpensive and readily easy to apply.

Updating is readily accomplished.

Sensitivity analysis is particularly simple since the contribution of any element to the mean can be analytically computed. For example, suppose we wish to examine the impact of changing the probability estimate for element 1 from .2 to .4. The new expected loss is $1.2 million (.4 times $3 million) and the adjusted expected loss is $1.6 million (.4/.75 times $3 million).

Disadvantages

The technique uses the BCE as a point of departure and is subject to the bias of the BCE.

The technique uses point probabilities of point costs as sub-estimates. This is a gross simplification of the real world and can lead to large errors.

The technique is highly dependent on the skill of

the analyst to identify and account for the various interdependencies.

The output is a point estimate which is always greater than the mean, but which cannot be related to the desired value of the TRACE (the median of the distribution).

Because the level of aggregation is high, the technique is quite sensitive to errors in the sub-estimates.

Overall Evaluation

In comparison with the Network Modeling Approach, the Risk Tabulation method appears weak, with the disadvantages far outweighing the advantages. However, in comparison to the previous techniques, it does provide a well defined, structured technique which forces a degree of disciplined analysis into the problem. For that reason it is preferred to earlier techniques. However, with minor modification, the TRACE Risk Tabulation method can be improved. A proposal for such improvement is presented in the next chapter.

CHAPTER III

FOOTNOTES

6. US Department of the Army, Deputy Chief of Staff for Research, Development and Acquisition, Letter of Instruction (LOI) for Implementation of RDTE Cost Realism for Current and Future Development Programs, dated 6 March 1975.

7. As of the date of this report, a Defense Documentation Center (DDC) Catalog Number was not available. The cited report was the deliverable under Contract DAAH01-76-C-10[illegible], US Army Missile Command, Redstone Arsenal, Alabama, 35809.

8. Frederick S. Hillier and Gerald J. Lieberman, <u>Introduction to Operations Research</u>, pp. 45[illegible]-46[illegible].

9. The network model used by Cockerham & Associates is proprietary to that firm. However the Army Logistics Management Center, Fort Lee, Virginia is currently modifying the Army's network model -RISCA (Risk Information System for Cost((and Schedule)) Analysis)- to provide the necessary features. Mr Thomas A Miller, Chairman, Decision Risk Analysis Committee, can provide up to date information on RISCA as well as other Army network models. (Commandant, US Army Logistics Management Center, ATTN: DRXMC-[illegible]-[illegible]CAD -Mr. Miller, Fort Lee, VA 23801. Autovon 687-[illegible].)

CHAPTER IV

A PROPOSED TECHNIQUE - RISK TABULATION/ EXPANSION

Two of the major disadvantages of the Risk Tabulation method are the use of point estimates as output and the heuristic adjustment of the expected values to get the final output. A modified technique is proposed which overcomes both these disadvantages.

PROBLEM FORMULATION

The initial formulation of the problem (figure 12) is the same as for the TRACE Risk Tabulation. However, the computation of the expected value and adjustment thereto is deleted. Instead, avery simple computer program (Annex [illegible]) is used to expand the program element estimates into their natural probability distribution, which is simply an estimate of the probability distribution of overall project cost.

COMPUTATION OF THE PROBABILITY DISTRIBUTION

Using the individual probabilities given in figure 12, the probability distribution is computed in a straightforward manner:

All possible combinations of impacts and non-impacts are enumerated and the associated probabilities

PROJECT Y
WEAPON SYSTEM RISK ASSESSMENT

Program Elements 1	Prob. of Occurrence P(A) 2	Cost Impact to Element/ Milestone TYPE A 3	Prob. of Occurrence P(B|A) 4	Prob. of Occurrence P(B) 5	Cost/Schedule Impact to Other Program Elements TYPE B 6	Date of Impact Calendar Date 7	Date of Impact FY 8
Vehicle							
1. Armor	.20	$3.0M	-	-	-	4/78	78
2. Suspension	.60	$ .4M	1.0	.60	$1M, 2MN*	6/78	78
3. Tracks	.25	$ .8M	-	-	-	6/78	78
4. Power Train	.60	$1.5M	.75	.45	$4M, 2MN*	9/78	78
5. Engine	.20	$ .5M	1.0	.20	$ .5M, .1MN, Engine Qualification	9/78	78
6. Integration	.75	$ .2M	1.0	.75	$2M, 2MN*	11/78	79
Program Milestones							
7. Initiate Acceptance Testing	.70	0.0	1.0	.70	$6M, 3MN*	2/79	79
8. OSD Review	.60	0.0	1.0	.60	$2.5M, 1MN*	7/79	79
9. DSARC	.30	0.0	1.0	.30	$4M, 2MN*	10/79	80

*Total Program Schedule Slips

FIGURE 12

and costs are computed . As an example, one of the 768 possible combinations in the example problem (figure 12) is: no impact in elements 1,2,3,5,6,and 8; a type A impact in element 4; and type A and B impacts in elements 7 and 9. The probability of this combination would be computed as: (1-.2)(1-.6)(1-.25)(.6)(1-.2)(1-.75)(.7 X 1.0)(1-.6)(.3) which is .000605. The associated cost is $11.5 million, consisting of $1.5 from element 4 (type A), $6 from element 7 (type A & B) and $4 from element 9 (type A & B).

After all possible combinations are evaluated, they are arranged in ascending order of cost, those combinations with equal costs are combined by adding together their probabilities, and a cumulative total of probabilities is also computed. Figures 13 and 14 display the results of the process for the sample problem. Figure 13 displays the input data for validation along with the mean, variance and standard deviation of the distribution, (these quantities are computed by the program as a side benefit), while Figure 14 is the listing of the distribution per se.

The computer program also produces two other output formats for special purposes. The first is a very detailed breakout showing each of the possible combinations of impacts along with the overall impact contribution (Annex C). This output is designed for the analyst who

TRACE RISK TABULATION DISTRIBUTION

I N P U T   P A R A M E T E R S

ACTIVITY	PROBABILITY OF TYPE A IMPACT	COST OF TYPE A IMPACT	CONDITIONAL PROBABILITY OF TYPE B IMPACT	COST OF TYPE B IMPACT
1	0.20	3.00	0.	0.
2	0.60	0.40	1.00	1.00
3	0.25	0.80	0.	0.
4	0.60	1.50	0.75	[illegible].00
5	0.20	0.50	1.00	0.50
6	0.75	0.20	1.00	2.00
7	0.70	0.	1.00	6.00
8	0.60	0.	1.00	2.50
9	0.30	0.	1.00	4.00

MEAN OF DISTRIBUTION 13.0900

VARIANCE OF DISTRIBUTION 22.177909

STANDARD DEVIATION OF DISTRIBUTION 4.709343

FIGURE 13

D I S T R I B U T I O N

COST	PROBABILITY	CUMULATIVE PROBABILITY
0.	0.001613	0.001613
0.8	0.000538	0.002150
1.0	0.000403	0.002554
1.4	0.002419	0.004973
1.5	0.000605	0.005578
1.8	0.000134	0.005712
2.2	0.005645	0.011357
2.3	0.000202	0.011558
2.4	0.000605	0.012163
2.5	0.002570	0.014734
2.9	0.000907	0.015641
3.0	0.002016	0.017657
3.2	0.001411	0.019068
3.3	0.000857	0.019925
3.5	0.000605	0.020530
3.6	0.007258	0.027787
3.7	0.002117	0.029904
3.8	0.000134	0.030038
3.9	0.003856	0.033894
4.0	0.002102	0.035996
4.3	0.000202	0.036198
4.4	0.003024	0.039222
4.5	0.000756	0.039978
4.6	0.001814	0.041792
4.7	0.008996	0.050789
4.8	0.000566	0.051355
4.9	0.000907	0.052262
5.0	0.000400	0.052662
5.1	0.002722	0.055384
5.2	0.001411	0.056795
5.3	0.000050	0.056845
5.4	0.003154	0.059999
5.5	0.005287	0.065285
5.7	0.002117	0.067402
5.8	0.000133	0.067535
5.9	0.001134	0.068669
6.0	0.004166	0.072836
6.1	0.011567	0.084403
6.2	0.005947	0.090350
6.3	0.000905	0.091255
6.4	0.000599	0.091855
6.5	0.002311	0.094166
6.6	0.001814	0.095980
6.7	0.000529	0.096509
6.8	0.001254	0.097764
6.9	0.007930	0.105694
7.0	0.003040	0.108733
7.1	0.002722	0.111455
7.2	0.001399	0.112854
7.3	0.000569	0.113422
7.4	0.006250	0.119672
7.5	0.001822	0.121494
7.6	0.007646	0.129140
7.7	0.009507	0.138647
7.8	0.000447	0.139093
7.9	0.003467	0.142560
8.0	0.003610	0.146170
8.1	0.000680	0.146851
8.2	0.013171	0.160022
8.3	0.000557	0.160579
8.4	0.004559	0.165138
8.5	0.009232	0.174370
8.6	0.001798	0.176163
8.7	0.005972	0.182141
8.8	0.001070	0.183211
8.9	0.002732	0.185943
9.0	0.005482	0.191425
9.1	0.012223	0.203648
9.2	0.004691	0.208339
9.3	0.002172	0.210511
9.4	0.005415	0.215926
9.5	0.004284	0.220210
9.6	0.016934	0.237144
9.7	0.005846	0.242991
9.8	0.000573	0.243564
9.9	0.013848	0.257412
10.0	0.005305	0.262717
10.1	0.007679	0.270396
10.2	0.011236	0.281632
10.3	0.000859	0.282491
10.4	0.008222	0.290714
10.5	0.002282	0.292996
10.6	0.006032	0.299028
10.7	0.022806	0.321834
10.8	0.001322	0.323155
10.9	0.006426	0.329581
11.0	0.004920	0.334502
11.1	0.007517	0.342018
11.2	0.006014	0.348033
11.3	0.000204	0.348237
11.4	0.007958	0.356195
11.5	0.012854	0.369048
11.6	0.014446	0.383495
11.7	0.009022	0.392516
11.8	0.000570	0.393086
11.9	0.003424	0.396510
12.0	0.003079	0.399589
12.1	0.029322	0.428911
12.2	0.013877	0.442788
12.3	0.002113	0.444901
12.4	0.007380	0.452281
12.5	0.006754	0.459035
12.6	0.007733	0.466767
12.7	0.002142	0.468909
12.8	0.000454	0.469363
12.9	0.019281	0.488644
13.0	0.005189	0.493833
13.1	0.011599	0.505432
13.2	0.005985	0.511417
13.3	0.001392	0.512809
13.4	0.004619	0.517428
13.5	0.001265	0.518693
13.6	0.017842	0.536535

FIGURE 14

13.7	0.022182	0.558717
13.8	0.000408	0.559125
13.9	0.010130	0.569255
14.0	0.009201	0.578456
14.1	0.002754	0.581210
14.2	0.004763	0.585973
14.3	0.000218	0.586191
14.4	0.007783	0.593974
14.5	0.007547	0.601521
14.6	0.007695	0.609216
14.7	0.014616	0.623832
14.8	0.002497	0.626329
14.9	0.001898	0.628227
15.0	0.003467	0.631694
15.1	0.028520	0.660214
15.2	0.004284	0.664498
15.3	0.000403	0.664901
15.4	0.013801	0.678702
15.5	0.006898	0.685600
15.6	0.006124	0.691723
15.7	0.002287	0.694010
15.8	0.000702	0.694712
15.9	0.011321	0.706033
16.0	0.001297	0.707330
16.1	0.018792	0.726122
16.2	0.026217	0.752340
16.3	0.000907	0.753247
16.4	0.005200	0.758447
16.5	0.001258	0.759705
16.6	0.005508	0.765213
16.7	0.004234	0.76[illegible]447
16.8	0.000024	0.7[illegible]9471
16.9	0.010346	0.779818
17.0	0.009305	0.789123
17.1	0.002940	0.792063
17.2	0.007371	0.799434
17.3	0.000202	0.799636
17.4	0.001945	0.801581
17.5	0.001210	0.802791
17.6	0.033708	0.836499
17.7	0.009526	0.846024
17.8	0.000605	0.846629
17.9	0.001887	0.848517
18.0	0.005281	0.853798
18.1	0.005443	0.859241
18.2	0.000255	0.859496
18.4	0.013958	0.873454
18.5	0.003175	0.876629
18.6	0.009477	0.886106
18.7	0.002117	0.888223
18.8	0.001058	0.889281
18.9	0.001814	0.891096
19.0	0.000753	0.891849
19.1	0.012247	0.904096
19.2	0.006350	0.910446
19.3	0.000151	0.910598
19.4	0.007922	0.918519
19.5	0.000718	0.919238
19.6	0.000328	0.919566
19.8	0.000227	0.919792

19.9	0.004763	0.924555
20.0	0.001814	0.926370
20.1	0.002722	0.929091
20.2	0.011113	0.940204
20.3	0.000038	0.940242
20.4	0.001130	0.941372
20.6	0.008165	0.949537
20.7	0.001588	0.951125
20.9	0.001077	0.952202
21.0	0.003856	0.956058
21.2	0.002381	0.959439
21.4	0.002722	0.961160
21.5	0.000454	0.961614
21.6	0.014288	0.975903
21.7	0.000397	0.976299
21.8	0.000227	0.976526
22.0	0.000851	0.977377
22.1	0.002041	0.979418
22.4	0.005783	0.985201
22.5	0.000113	0.985315
22.6	0.003062	0.988377
22.8	0.000057	0.988433
22.9	0.000680	0.989114
23.1	0.000510	0.989624
23.2	0.002381	0.992005
23.4	0.001276	0.993281
23.9	0.000170	0.993451
24.0	0.000680	0.994132
24.2	0.000595	0.994727
24.6	0.003062	0.997789
25.0	0.000170	0.997959
25.4	0.001021	0.998979
25.6	0.000765	0.999745
26.4	0.000255	1.000000

FIGURE 14 (continued)

desires full visibility into specific combinations for detailed examination, such as evaluating probable time of impact for programming purposes. The second format aggregates the costs into broad cost bands for graphing, and will be further discussed later in the paper.

USE OF THE PROBABILITY DISTRIBUTION

The additional usefulness of the modified Risk Tabulation approach can be demonstrated by comparison of figures 13 and 14 with figure 11.

First, it should be noted that both methods provide a mean (expected) loss of $13.09 million, which is to be expected since they use the same basic estimates. In figure 11, the heuristic adjustment to the expected value produced a TRACE Margin of $17.46 million. However, reference to figure 14 reveals that $17.46 million is at the 80th percentile of the distribution - - quite a deviation from the DA guidance to fund at the 50th percentile, and definitely an over-conservative approach.

From figure 14, it can be seen that the median cost estimate is approximately $13.05 million. Therefore, adherence to the ASA(R&D) guidance indicates a TRACE Margin of $13.05 million. Use of the modified approach in the sample problem then would have "freed" $4.35

million (17.45 - 13.05) for other programs, while maintaining the required probability of avoiding an overrun.

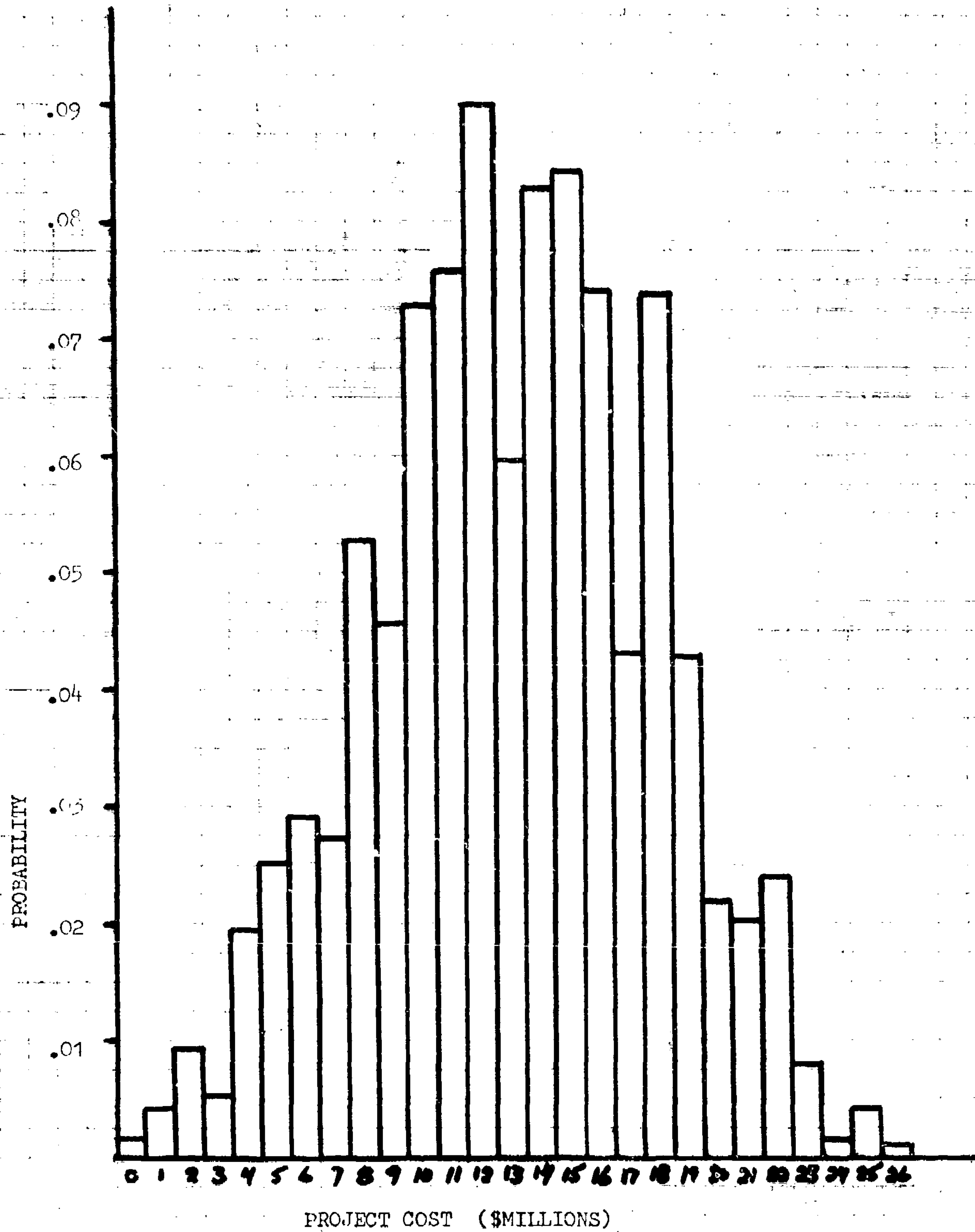
Should the situation demand deviation from the nominal ACM(MD) guidance, the probability distribution provides a solid basis for response. For example, should a project be one of high visability, so that only a 40 per cent chance of overrun is desired, an estimate can be taken directly from figure 14 as the 60th percentile ($14.45 million for the sample problem).

Another use of the probability distribution is to provide a graphic display of the funding probability profile. The computer program has an optional output designed to facilitate graphing. This output (Figure 15) merely combines all costs into bands which include those costs within + 0.5 million of the stated value and computes the associated probability. In the sample problem, for example, the probability of a cost between $11.5 and $12.5 million is .089936, and the probability of a cost less than $12.5 million is .459035. The graph made from this output is shown in Figure 16, and supplies a useful picture to complement the printed outputs. It can be seen that the bulk of the probability distribution is concentrated between $10 and $18 million, and that the

D I S T R I B U T I O N

COST	PROBABILITY	CUMULATIVE PROBABILITY
0.	0.001613	0.001613
1.0	0.003965	0.005578
2.0	0.009156	0.014734
3.0	0.005795	0.020530
4.0	0.019448	0.039978
5.0	0.025307	0.065285
6.0	0.028880	0.094166
7.0	0.027328	0.121494
8.0	0.052877	0.174370
9.0	0.045840	0.220210
10.0	0.072786	0.292996
11.0	0.076053	0.369048
12.0	0.089986	0.459035
13.0	0.059658	0.518693
14.0	0.082828	0.601521
15.0	0.084079	0.685600
16.0	0.074106	0.759705
17.0	0.043085	0.802791
18.0	0.073838	0.876629
19.0	0.042609	0.919238
20.0	0.022135	0.941372
21.0	0.020242	0.961614
22.0	0.023701	0.985315
23.0	0.007966	0.993281
24.0	0.001446	0.994727
25.0	0.004253	0.998979
26.0	0.001021	1.000000

FIGURE 15



PROBABILITY
.09
.08
.07
.06
.05
.04
.02
.01
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
PROJECT COST ($MILLIONS)

FIGURE 16

most likely overrun is in the \$11.5 - \$12.5 million cost band. Thus, the 50th percentile value of \$13.05 million not only meets the DA guidance, but also includes the most likely overrun value, which provides some measure of comfort. In general, the graphic display shown in figure 16 provides a good quick picture of the cost probability distribution for management level evaluation, with the more detailed computer printouts available for analyst level activity.

DISCUSSION OF THE PROPOSED APPROACH

The TRACE Risk Tabulation/ Expansion approach is not proposed to replace the Network Modeling technique. Certainly, where the size of the project and availability of supporting resources justify its use, the Network Model should be used - - it is "state of the art". However, where the Network approach does not seem justified, or is not feasible, the TRACE Risk Tabulation / Expansion provides considerably greater utility and project visibility than any of the other approaches.

FURTHER REFINEMENTS

The TRACE Risk Tabulation/ Expansion technique can be expanded to provide more definitive programming (i.e., time-phasing) information. The general approach

is to divide the program elements into subsections by fiscal year, and then to expand the probability distributions for both cost and schedule each year. This will provide a more convenient basis for per year allocation of TRACE Margin funds.

CHAPTER V

GENERAL OBSERVATIONS ON TRACE IMPLEMENTATION

During the course of researching this paper, the author had contact with a broad cross-section of personnel associated with the implementation of the TRACE concept, ranging from Mr. Augustine down to cost analysis personnel within commodity commands and Project Management Offices. The observations made, while not of direct application to the topic at hand, seem to merit documentation. This section will list those observations.

SUPPORT FOR THE TRACE

Generally, the TRACE concept is well supported at Headquarters, DA, and at Headquarters, US Army Development and Readiness Command (DARCOM). At the DARCOM subordinate command level, support is spotty, and at PMO level, with some exceptions, TRACE is intensely disliked. Typical PMO comments follow:

"TRACE is a meaningless exercise in obfuscation." "TRACE simply deprives me of funds I should have - - I know that Project Y is in trouble and I will lose my TRACE Margin funds to PM Y." "No matter what anyone says, the TRACE Margin is a management reserve and the PM needs that reserve, not DCSRDA."

Overall, it appears that PMs are complying with the requirements for the TRACE Margin only because it is required, and that the compliance is, in general, done very begrudgingly. (There are, it is emphasized, a few exceptions who vigorously and enthusiastically support the TRACE concept.)

UNDERSTANDING OF THE TRACE

Generally it was found that the TRACE concept was understood by working level personnel at all levels. However, at the management level, there are as many different interpretations of the TRACE as there are managers. Specifically, there appears to be a lack of understanding of the distinction between TRACE Margin and Management Reserve, a failure to recognize that some overruns are expected, as well as underruns, and lack of understanding of the rationale for maintainig high level control of TRACE Margin funds. In a number of cases, PMs are demonstrating their misunderstanding of TRACE by attempting to program the use of TRACE Margin funds.

IMPLEMENTATION OF TRACE

Overall, the initial implementation of TRACE was "most of the pants" -- again with a few exceptions.

When faced with the requirement to designate a TRACE Margin, most PMs simply coughed up all or a portion of their management reserve and relabeled it TRACE Margin. It does appear that newer projects and those ongoing projects which are being restructured, are doing a better job of complying with the TRACE concept.

SHORTCOMINGS OF THE TRACE CONCEPT

Notwithstanding the progress being made in improving TRACE implementation, it must be recognized that there are anumber of shortcomings inherent in TRACE per se (as opposed to those peculiar to specific implementation techniques). These are listed below in outline format.

Incompatiblity with PPBS

The requirement to program funds on a fiscal year basis places a severe constraint on TRACE. Ideally, the TRACE Margin should be funded on an any year basis, so that unused funds in one year could be carried over to support potential problems in later years, or conversely, so that funds would be available to cover high overruns in the early years, hopefully to be offset by underruns in later years.(This problem is hardly unique to TRACE, but is highlighted by the impact it has on TRACE.

The requirement to include TRACE Margin funds in the [illegible] line items (project element lines) creates two problems:

It defeats the basic thrust of TRACE -- that the savings accrued in those 50% of the projects which underrun can offset the overruns in the other 50% of the projects. This can be done now only through reprogramming (in general), which subjects the available funds to possible withdrawal by higher authority.

It allows contractor knowledge of actual fund availability. Since contractors have access to line item totals, they can readily estimate the actual money available to them by subtracting out the total government "in-house" costs, which are fairly easy to estimate. Thus the PMs efforts to stay within their DCP may be thwarted by contractor knowledge of the amount of additional funding actually available.

One possible solution to these problems is to create (assuming necessary statutory/regulatory approvals) a separate contingency line, in which all TRACE Margins are carried, and thus lose their project identity. This solution would help greatly with the fiscal year programming problem since cross reimbursement on a free basis in any given year would ameliorate many of the multi-year problems. However, its effect on the contractor

knowledge situation is difficult to assess. Now the contractor does not see the TRACE Margin allocated to his risk, but he does see the overall pool, and must estimate how much is his "share". The question now is -- will he overestimate or underestimate his "share"? Discussion of that question is beyond the scope of this paper, but it is clear that if a few contractors were to overestimate, severe problems would ensue.

A further consideration in adoption of TRACE Margin "pooling" is that of possible higher echelon pooling. If the Army could present adequate argument to secure permission to "pool", that argument would tend to support and even encourage a grand pool at DOD level, thus denying the Army the flexibility sought in the first place.

Treatment of Technical Risk

All the techniques thus far derived for TRACE implementation do not explicitly treat technical risk, but instead focus on cost and schedule risk, with technical risk being at best an implicit factor. This approach is natural, since cost growth and schedule slippage are indeed the principle manifestations of technical risk. Nonetheless, it appears that more explicit treatment of technical risk could add to the usefulness and validity of the TRACE.

Inflexibility in TRACE Margin Administration

This problem revolves around bureaucratic inflexibility in releasing TRACE Margin funds to PMs. Because the various directives pertaining to TRACE speak specifically to using TRACE Margins to fund overruns of the BCE, PMs are not being encouraged to use their available TRACE Margin funds to prevent future overruns. For example, there appears to be a philosophy that FY77 TRACE Margin funds can only be used to pay for overruns which require FY77 dollars. In fact, a more efficient use of those funds, if they are not required to pay for current overruns, is to fund necessary activities to prevent future overruns. Generally speaking, funds used in the "overrun prevention" mode will provide much greater return than those used in the "overrun compensation" mode. Care must be taken, of course, that proper and complete justification is provided, and that the use of TRACE Margin funds for overrun prevention is in response to newly identified problems (as opposed to previously known problems which could have been resolved through the normal programming process).

CHAPTER VI

RECOMMENDATIONS

It is recommended that:

The TRACE Risk Tabulation/ Expansion Technique be established as the minimum acceptable approach to TRACE implementation.

The TRACE Network Modeling Technique be used whenever project size available support make it possible.

Additional emphasis be placed on using the TRACE structure as a mangement tool for monitoring and controling the project. The TRACE should be updated as significant events are completed as well as routinely, on a calender basis.

Work be expedited to implement a TRACE Network Modeling capability on existing Army Network Models such as RISCA.

Additional work be done to improve the realism and treatment of interdependencies in Army Network Models, to provide a technique for extracting outputs by fiscal year, and to provide explicit schedule risk outputs.

Additional instruction on detailed TRACE methodologies be incorporated into the Program of Instruction at the Army Logistics Management Center and related

schools.

The inclusion of explicit consideration of technical risk in TRACE methodology be evaluated.

The administration of TRACE Margin funds be redirected to encourage PMs to use available TRACE Margin funds to prevent future overruns as well as pay for current overruns.

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ANNEX A

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, D.C. 20310

12 JUL 1974

MEMORANDUM FOR THE DIRECTOR OF THE ARMY STAFF

SUBJECT: RDT&E Cost Realism -- Future Development Programs

One of the strongest criticisms leveled against the Department of Defense in recent years has, I believe, related to the difficulty of controlling the costs of development activities. The present memorandum addresses development costs; however, the action proposed could equally apply to the estimation of production "design-to" costs.

It is noted that the problem in the past has not been the need of a method for fine-tuning cost estimates to, say, the nearest 2 or 3 or even 10%. Rather, the problem has been one of finding a means of avoiding gross errors on the order of 50 to 100% and more. We have rarely, if ever, had an underrun on a major program. However, it is not our objective to establish program cost estimates so high that there would be underruns in a large majority of cases. Our estimate should be unbiased so that we have about an even chance of either going over or under it.

It is submitted that cost overruns will continue to be a way of life until adequate recognition is given to the impact of program uncertainty in estimating costs. There are, of course, many types of uncertainties that influence program costs, such as unforeseen program changes, inflation, inaccurate cost estimating, technical problems, threat revisions, etc. It is particularly important for the Army to improve our capability as a "sophisticated buyer" in the analysis, evaluation and validation of program proposals by industry.

RDT&E cost estimates have traditionally been based on an approach which compiles expected costs for specifically identified tasks. It is, of course, important that we continue to refine our ability to identify those essential tasks and to prepare plans for their efficient accomplishment. But beyond this, it remains the fundamental nature of RDT&E, wherein by definition one is producing a particular item for the first time, to involve the unknown. These unknowns invariably lead to cost

requirements which cannot be individually foreseen at the outset of a development -- yet their cumulative impact can be seen in retrospect with all the assuredness of the laws of probability. The record shows a major factor in properly estimating RDT&E cost is, therefore, to assess realistically the probable gross extent of the unknowns in a program in advance -- i.e., the certain uncertainties.

The lessons of history strongly suggest that even the most capable program manager is not able to forecast all the problems which will be encountered in a development program which typically spans six to ten years into the future. It is, however, quite possible to conduct a risk analysis and thereby forecast, statistically, the probable additional funds which will be required to overcome these certain uncertainties. The provision of flexibility in the funding plan for such purposes does not represent the creation of a "slush fund," or a "reserve" (in the usual context), but rather merely gives due recognition to the fact that unanticipated problems always have, and always will, arise even in the best managed RDT&E programs ... and that our base-line cost estimates should reflect these probable additional costs.

The provision of additional planning funds commensurate with the assessed risk in proposed programs does, of course, mean that the effort to justify these new programs will be more difficult. Similarly, it will not be possible to start as many new programs if they must all fit into a given out-year budget projection. On the other hand, it seems far preferable to recognize these realities at the outset rather than part way through a development at which time cost growth in one program can often be compensated only by the inefficient mechanism of cancelling still other partly completed programs.

It is, therefore, proposed that a Total Risk Assessing Cost Estimate (TRACE) be generated for all future development programs and used as the basis for justifying those programs. The TRACE estimate is defined as one having a 50:50 chance of producing either an overrun or an underrun. One possible method of aggregating the TRACE estimate is:

(1) A "risk factor" would be assigned to each element of the program's work breakdown structure (probably a three-level structure is adequate for this purpose and should be available early in the program). A risk factor of 1.0 would correspond to a routine task with no risk

whatsoever. A factor of 1.3, for example, would characterize an effort wherein experience indicates that tasks which are not explicitly definable at the outset will most probably exceed those which are, in fact, definable by an expected value of about 30%. (The actual magnitude of the risk factor can generally be determined by a comparison of the degree of departure of the proposed task from corresponding tasks which have been accomplished in the past and by an assessment of the uncertainty which exists in the performance demanded of the item.)

(2) The risk factor would be multiplied by the basic cost estimate for the known efforts to be performed in each element of the work breakdown structure. An aggregate of these weighted costs would then provide a cost estimate for the program which recognizes the certain uncertainties which invariably arise in a development program.

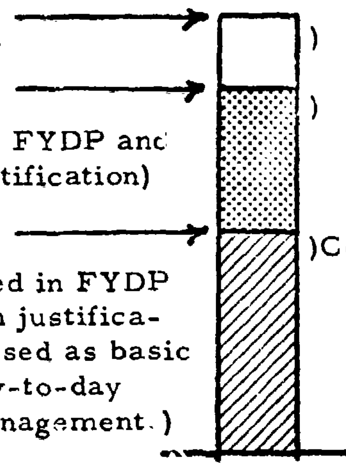
(3) The TRACE estimate would make use of all supportable estimating techniques such as Independent Parametric Cost Estimating (IPCE).

(4) The forecast of fund requirements which has been defined after consideration of uncertainties in the above manner would generally (although not necessarily always) be included in the latter years of the development funding plan. By so doing it is not necessary to justify the budgeting of these funds to Congress in a given year until the specific reason for needing them has, in fact, become known. Further, if, by the law of averages, some of the funds on an individual program are not ultimately needed, they can simply be dropped from the then-year budget request before it is submitted to Congress.

(5) The development activity would continue to be managed on a day-to-day basis against the nominal cost estimate (i.e., without risk funding), making the additional funds available to the Project Manager only when formally requested and adequately justified.

(6) All new R&D programs will be discussed with the user and justified to OSD and to the Congress using the TRACE figure (i.e., the cost estimate including the expected impact of risk). Program threshold cost estimates in the DCP would be no less than the TRACE estimate and generally greater.

This concept is shown schematically in the following sketch:



In summary, it should be emphasized that the approach proposed herein is not one of creating unverified contingency funds or slush funds or self-fulfilling cost estimates. To the contrary, it merely gives recognition to the established fact that every individual funding demand which will arise in a 6-10 year development effort simply cannot be explicitly identified in advance -- but that the aggregate of those demands can be reasonably predicted and should, therefore, be included in program planning.

It should be noted that the problem being addressed herein is related to, but intentionally separated from, the also very difficult problem of predicting inflation. This latter task need not be allowed to complicate the matter considered herein of properly accounting for those factors which are largely within the control of program management.

Unless you have some objection to the policy and procedures expressed above, please have them implemented in appropriate Army materiel acquisition directives.

Norman R. Augustine

Norman R. Augustine
Assistant Secretary of the Army
(Research and Development)

SECRETARY OF THE ARMY
WASHINGTON

July 12, 1974

MEMORANDUM FOR THE CHIEF OF STAFF

SUBJECT: RDT&E Cost Realism -- Current and Future Development Programs

Past experience in the acquisition of major weapons systems indicates that we generally exceed our initial cost estimates ... sometimes by as much as 100% or more. This problem, of course, is not unique to the Army. However, to prevent misleading the decision makers who approve our programs, we must produce more accurate cost estimates for the development of our major weapons systems.

The accuracy of our major program cost estimates is influenced by many factors including inflation, poor estimating, changing requirements, technical risk, etc. Risk is inherent in any research and development program and, generally, the greater the risk, the greater the potential payoff of the program. Unfortunately, there also appears to be a direct correlation between the degree of risk and the difficulty of producing accurate cost estimates.

While we cannot eliminate all technical risk from our programs nor precisely predict specific problems that will occur, we can, from past experience, assess their impact statistically and consider this in our RDT&E program plans. The problem of generating RDT&E cost estimates that more accurately reflect probable outcomes has undergone a review by elements of the Secretariat and the Army Staff and a revised policy has resulted. Under this revised policy we would no longer follow the practice of programming based only upon those tasks which can be clearly foreseen at the outset of a program and which therefore do not allow for uncertainty. By applying this Total Risk Assessing Cost Estimate (TRACE) approach, I am convinced that we can provide more accurate data in support of our programs at the OSD and Congressional levels. I have asked the ASA(R&D) to provide the details of the TRACE concept directly to your staff and would be appreciative of your helping implement this policy guidance.

Howard H. Callaway

ANNEX B

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF STAFF
WASHINGTON, D.C. 20310

5 August 1974

MEMORANDUM FOR: SECRETARY OF THE ARMY

SUBJECT: RDTE Cost Realism -- Current and Future Development Progra[illegible]

We have begun the process of implementing the policy of RDTE cost realism enunciated by you and Assistant Secretary Augustine in your 12 July 1974 memoranda. Your policy will receive high visibility here and in the field.

For each current development program qualifying for decision by the ASARC, the Chief of Research, Development and Acquisition is requesting a one-page review from the materiel developer. Each review will show what changes would be needed in a program to provide 10% and 20% margins of estimated funding from FY76 to completion of development. These reviews will be evaluated at HQDA by 30 September 1974 for the purpose of making specific pro[illegible]am recommendations.

For future development [illegible]ograms, the Chief of Research, Development and Acquisition, working wi[illegible] the Comptroller of the [illegible] (Director of Cost Analysis), will issue [illegible] letter of instruction on 1 October 1974. This will be an inter[illegible]m doc[illegible]nt to implement your policy, pending revision of Army regulati[illegible]ns.

FRED C. WEYAND
General, United States Army
Vice Chief of Staff

```
*#RUN *=/RAND/RUNV(ULIB,CORE=24K,REMO)LIBRARY/USERLIB,R
      DIMENSION A(9),B(9),D(9),E(9)
      DIMENSION PROB(1000),COST(1000),INDIC(1000,9),P(9,3),C(9,3)
C     READ IN BASIC VALUES, A(I)=PROB OF TYPE A COST FOR THE
C     ITHACTIVITY, B(I)=PROB OF TYPE B COST FOR THE ITH
C     ACITIVTY, D(I) = AMOUNT OF TYPE A COST, E(I) = AMOUNT
C     OF TYPE B COST
      CALL FPARAM ( 1 , 132 )
      CALL CREATE(21,30000,0,ISTAT)
      WRITE( 21 , 9060 )
      PRINT,"ENTER A PROB, A COST, B PROB, B COST"
      DO 65 I=1,9
        READ, A(I), D(I), B(I), E(I)
        WRITE(21,9010)I,A(I),D(I),B(I),E(I)
   65 CONTINUE
      PRINT,"ENTER IOPT"
      READ,IOPT
C     IF IOPT = 1 PRINT COMPLETE DISTRIBUTION WITH INDICATORS
C     IF IOPT = 2 PRINT COMPLETE DISTRIBUTION W/O INDICATORS
C     IF IOPT = 3 PRINT ABBREVIATED DISTRIBUTION
      DO 7 I=1,9
        P(I,1)=A(I)*(1.0 -B(I))
        P(I,2)=A(I)*B(I)
        P(I,3)=1.0-A(I)
        C(I,1)=D(I)
        C(I,2)=D(I)+E(I)
    7 C(I,3)=0.0
      IND=0
      EXPECT = 0.
      VAR = 0.
      DO 10 I=1,3
      DO 10 J=1,3
      DO 10 K=1,3
      DO 10 L=1,3
      DO 10 M=1,3
      DO 10 N=1,3
      DO 10 II = 1 , 3
      DO 10 JJ = 1 , 3
      DO 10 KK = 1 , 3
        IND=IND+1
        PROB(IND)=P(1,I)*P(2,J)*P(3,K)*P(4,L)*P(5,M)*P(6,N)
     &           *P(7,II)*P(8,JJ)*P(9,KK)
        IF(PROB(IND).GT.0.0)GO TO 12
        IND=IND-1
        GO TO 10
   12   GO TO ( 11 , 13 , 13 ) , IOPT
   11   INDIC(IND,1)=I
        INDIC(IND,2)=J
        INDIC(IND,3)=K
        INDIC(IND,4)=L
        INDIC(IND,5)=M
        INDIC(IND,6)=N
        INDIC(IND,7) = II
        INDIC(IND,8) = JJ
        INDIC(IND,9) = KK
   13   COST(IND)=C(1,I)+C(2,J)+C(3,K)+C(4,L)+C(5,M)+C(6,N)
     &           +C(7,II)+C(8,JJ)+C(9,KK)
        EXPECT = EXPECT + (PROB(IND)*COST(IND))
        VAR = VAR + (PROB(IND)*(COST(IND)**2))
   10 CONTINUE
      IVAL=IND
```

```
      IVAL=IND
      VAR = VAR - (EXPEC(**2)
      STDDEV = SQRT ( VAR )
      DO 20 J=1,IVAL-1
        JA=J+1
        DO 19 K=JA,IVAL
          IF(COST(J).LE.COST(K))GO TO 19
          TEMP=COST(J)
          COST(J)=COST(K)
          COST(K)=TEMP
          TEMP=PROB(J)
          PROB(J)=PROB(K)
          PROB(K)=TEMP
          GO TO ( 14 , 19 , 19 ) , IOPT
   14     DO 18 L=1,9
            KT=INDIC(J,L)
            INDIC(J,L)=INDIC(K,L)
            INDIC(K,L)=KT
   18     CONTINUE
   19   CONTINUE
   20 CONTINUE
      WRITE(21,9030) EXPECT , VAR , STDDEV
      CUM=0.0
      IF ( IOPT .EQ. 1 ) WRITE ( 21 , 9020 ) (I(J),J = 1 , 9)
      IF ( IOPT .NE. 1 ) WRITE ( 21 , 9050 )
      GO TO ( 50 , 30 , 70 ) , IOPT
   50 DO 40 I=1,IVAL
        CUM=CUM+PROB(I)
   40 WRITE(21,21)COST(I),PROB(I),CUM,INDIC(I,1),
      INDIC(I,2),INDIC(I,3),INDIC(I,4),INDIC(I,5),INDIC(I,6)
     &           ,INDIC(I,7),INDIC(I,8),INDIC(I,9)
      GO TO 78
   30 I = 0
   31 PTEMP = 0.0
   32 I = I + 1
      PTEMP = PTEMP + PROB(I)
      IF ( IVAL - I ) 78 , 34 , 33
   33 IF ((COST(I+1) - COST(I)).LE..0005 ) GO TO 32
   34 CUM = CUM + PTEMP
      WRITE(21,9040)COST(I),PTEMP,CUM
      IF ( IVAL - I ) 78 , 78 , 31
   70 Q = -0.5
      I = 0
   71 PTEMP = 0.0
      Q = Q + 1.0
   72 I = I + 1
   73 IF ((COST(I)-Q).GT..00005) GO TO 75
   74 PTEMP = PTEMP + PROB(I)
      IF ( I - IVAL ) 76 , 77 , 78
   75 Q = Q + 1.0
      GO TO 73
   76 IF ((COST(I+1) - Q).LE..00005 ) GO TO 72
   77 CUM = CUM + PTEMP
      Z = Q - 0.5
      WRITE(21,9040) Z,PTEMP,CUM
      IF ( I - IVAL ) 71 , 78 , 78
   78 CALL APRINT(21,"AAWCSDP/30/AWCSDP**,D/VENZKE",20,"3A ")
      CALL DETACH(21,ISTAT,)
   21 FORMAT(T7,F6.1,4X,F10.6,5X,F10.6,7X,I1,8(8X,I1))
 9010 FORMAT(T5,I2,T34,F4.2,T55,F5.2,T85,F4.2,T113,F4.2)

 9020 FORMAT("1",/,T54,"D I S T R I B U T I O N",/////
     &      ,T60,"A C T I V I T Y   S T A T U S",/
```

```
9020 FORMAT("1",/,T54,"D I S T R I B U T I O N",/////
     &       ,T68,"A C T I V I T Y   S T A T U S",/
     &       ,T9,"COST",T17,"PROBABILITY",T32,"CUMULATIVE"
     &       ,T54,"( 1 = TYPE A IMPACT, 2 = TYPE A AND B IMPACTS,"
     &       ," 3 = NO IMPACTS)",/,T32,"PROBABILITY"
     &       ,9(4X,"ACT-",I1,),//)
9030 FORMAT(///,T12,"MEAN OF DISTRIBUTION",5X,F7.4,///
     &       ,T12,"VARIANCE OF DISTRIBUTION",5X,F10.6,///
     &       ,T12,"STANDARD DEVIATION OF DISTRIBUTION",5X,F10.6)
9040 FORMAT(T47,F6.1,4X,F10.6,5X,F10.6)
9050 FORMAT("1",/,T54,"D I S T R I B U T I O N",/////
     &       ,T49,"COST",4X,"PROBABILITY",4X,"CUMULATIVE",/
     &       ,T72,"PROBABILITY")
9060 FORMAT("1",/////////,T48,"TRACE  RISK TABULATION DISTRIBUTION",////
     &       ,T50,"I N P U T   P A R A M E T E R S",////
     &       ,T12,"ACTIVITY",T29,"PROBABILITY OF",T55,"COST OF"
     &       ,T74,"CONDITIONAL PROBABILITY OF",T112,"COST OF",/
     &       ,T29,"TYPE  A IMPACT",T52,"TYPE A IMPACT"
     &       ,T80,"TYPE  B IMPACT",T109,"TYPE B IMPACT",//)
      STOP
      END
```

ANNEX C

TRACE RISK TABULATION DISTRIBUTION

INPUT PARAMETERS

ACTIVITY	PROBABILITY OF TYPE A IMPACT	COST OF TYPE A IMPACT	CONDITIONAL PROBABILITY OF TYPE B IMPACT	COST OF TYPE B IMPACT
1	0.20	3.00	0.	0.
2	0.60	0.40	1.00	1.00
3	0.25	0.80	0.	0.
4	0.60	1.50	0.75	4.00
5	0.20	0.50	1.00	0.50
6	0.75	0.20	1.00	2.00
7	0.70	0.	1.00	6.00
8	0.60	0.	1.00	2.50
9	0.30	0.	1.00	4.00

MEAN OF DISTRIBUTION 13.0900

VARIANCE OF DISTRIBUTION 22.177909

STANDARD DEVIATION OF DISTRIBUTION 4.709343

DISTRIBUTION

D I S T R I B U T I O N

A C T I V I T Y   S T A T U S
(1 = TYPE A IMPACT, 2 = TYPE A AND B IMPACTS, 3 = NO IMPACTS)

COST	PROBABILITY	CUMULATIVE PROBABILITY	ACT-1	ACT-2	ACT-3	ACT-4	ACT-5	ACT-6	ACT-7	ACT-8	ACT-9
0.	0.001613	0.001613	3	3	3	3	3	3	3	3	3
0.8	0.000539	0.002150	3	3	1	3	3	3	3	3	3
1.0	0.000403	0.002554	3	3	3	3	2	3	3	3	3
1.4	0.002419	0.004973	3	2	3	3	3	3	3	3	3
1.5	0.000605	0.005578	3	3	3	1	3	3	3	3	3
1.8	0.000134	0.005712	3	3	1	3	2	3	3	3	3
2.2	0.004838	0.010550	3	3	3	3	3	2	3	3	3
2.2	0.000806	0.011357	3	2	1	3	3	3	3	3	3
2.3	0.000202	0.011558	3	3	1	1	3	3	3	3	3
2.4	0.000605	0.012163	3	2	3	3	2	3	3	3	3
2.5	0.002419	0.014582	3	3	3	3	3	3	3	2	3
2.5	0.000151	0.014734	3	3	3	1	2	3	3	3	3
2.9	0.000907	0.015641	3	2	3	1	3	3	3	3	3
3.0	0.001613	0.017254	3	3	1	3	3	2	3	3	3
3.0	0.000403	0.017657	1	3	3	3	3	3	3	3	3
3.2	0.001210	0.018866	3	3	3	3	2	2	3	3	3
3.2	0.000202	0.019068	3	2	1	3	2	3	3	3	3
3.3	0.000050	0.019118	3	3	1	1	2	3	3	3	3
3.3	0.000806	0.019925	3	3	1	3	3	3	3	2	3
3.5	0.000605	0.020530	3	3	3	3	2	3	3	2	3
3.6	0.007258	0.027787	3	2	3	3	3	2	3	3	3
3.7	0.001814	0.029602	3	3	3	1	3	2	3	3	3
3.7	0.000302	0.029904	3	2	1	1	3	3	3	3	3
3.8	0.000134	0.030038	1	3	1	3	3	3	3	3	3
3.9	0.000227	0.030265	3	2	3	1	2	3	3	3	3
3.9	0.003629	0.033894	3	2	3	3	3	3	3	2	3
4.0	0.000403	0.034297	3	3	1	3	2	2	3	3	3
4.0	0.000907	0.035204	3	3	3	1	3	3	3	2	3
4.0	0.000691	0.035896	3	3	3	3	3	3	3	3	2
4.0	0.000101	0.035996	1	3	3	3	2	3	3	3	3
4.3	0.000202	0.036198	3	3	1	3	2	3	3	2	3
4.4	0.000605	0.036803	1	2	3	3	3	3	3	3	3
4.4	0.002419	0.039222	3	2	1	3	3	2	3	3	3
4.5	0.000151	0.039373	1	3	3	1	3	3	3	3	3
4.5	0.000605	0.039978	3	3	1	1	3	2	3	3	3
4.6	0.001814	0.041792	3	2	3	3	2	2	3	3	3
4.7	0.000454	0.042246	3	3	3	1	2	2	3	3	3
4.7	0.007258	0.049504	3	3	3	3	3	2	3	2	3
4.7	0.000076	0.049579	3	2	1	1	2	3	3	3	3
4.7	0.001210	0.050789	3	2	1	3	3	3	3	2	3
4.8	0.000230	0.051019	3	3	1	3	3	3	3	3	2
4.8	0.000034	0.051053	1	3	1	3	2	3	3	3	3
4.8	0.000302	0.051355	3	3	1	1	3	3	3	2	3
4.9	0.000907	0.052262	3	2	3	3	2	3	3	2	3
5.0	0.000227	0.052489	3	3	3	1	2	3	3	2	3
5.0	0.000173	0.052662	3	3	3	3	2	3	3	3	2
5.1	0.002722	0.055384	3	2	3	1	3	2	3	3	3
5.2	0.001210	0.056593	1	3	3	3	3	2	3	3	3
5.2	0.000202	0.056795	1	2	1	3		3	3	3	3
5.3	0.000050	0.056845	1	3	1	1	3	3	3	3	3
5.4	0.001037	0.057882	3	2	3	3	3	3	3	3	2
5.4	0.000151	0.058033	1	2	3	3	2	3	3	3	3
5.4	0.000605	0.058638	3	2	1	3	2	2	3	3	3
5.4	0.001361	0.059999	3	2	3	1	3	3	3	2	3
5.5	0.000259	0.060258	3	3	3	1	3	3	3	3	2

5.4	0.000151	0.059033	1	2	3	3	2	3	3	3	3
5.4	0.000605	0.058638	3	2	1	3	2	2	3	3	3
5.4	0.001361	0.059999	3	2	3	1	3	3	3	2	3
5.5	0.000259	0.060258	3	3	3	1	3	3	3	3	2
5.5	0.000151	0.060409	3	3	1	1	2	2	3	3	3
5.5	0.001814	0.062224	3	3	3	2	3	3	3	3	3
5.5	0.000605	0.062828	1	3	3	3	3	3	3	2	3
5.5	0.002419	0.065248	3	3	1	3	3	2	3	2	3
5.5	0.000038	0.065285	1	3	3	1	2	3	3	3	3
5.7	0.001814	0.067100	3	3	3	3	2	2	3	2	3
5.7	0.000302	0.067402	3	2	1	3	2	3	3	2	3
5.8	0.000076	0.067478	3	3	1	1	2	3	3	2	3
5.8	0.000058	0.067535	3	3	1	3	2	3	3	3	2
5.9	0.000907	0.068443	3	2	1	1	3	2	3	3	3
5.9	0.000227	0.068669	1	2	3	1	3	3	3	3	3
6.0	0.003763	0.072433	3	3	3	3	3	3	2	3	3
6.0	0.000403	0.072836	1	3	1	3	3	2	3	3	3
6.1	0.000680	0.073516	3	2	3	1	2	2	3	3	3
6.1	0.010886	0.084403	3	2	3	3	3	2	3	2	3
6.2	0.002074	0.086476	3	3	3	3	3	2	3	3	2
6.2	0.002722	0.089198	3	3	3	1	3	2	3	2	3
6.2	0.000302	0.089500	1	3	3	3	2	2	3	3	3
6.2	0.000746	0.089846	3	2	1	3	3	3	3	3	2
6.2	0.000050	0.089896	1	2	1	3	2	3	3	3	3
6.2	0.000454	0.090350	3	2	1	1	3	3	3	2	3
6.3	0.000202	0.090551	1	3	1	3	3	3	3	2	3
6.3	0.000605	0.091156	3	3	1	2	3	3	3	3	3
6.3	0.000013	0.091169	1	3	1	1	2	3	3	3	3
6.3	0.000086	0.091255	3	3	1	1	3	3	3	3	2
6.4	0.000340	0.091595	3	2	3	1	2	3	3	2	3
6.4	0.000259	0.091855	3	2	3	3	2	3	3	3	2
6.5	0.000151	0.092006	1	3	3	3	2	3	3	2	3
6.5	0.001037	0.093043	3	3	3	3	3	3	3	2	2
6.5	0.000065	0.093107	3	3	3	1	2	3	3	3	2
6.5	0.000454	0.093561	3	3	3	2	2	3	3	3	3
6.5	0.000605	0.094166	3	3	1	3	2	2	3	2	3
6.6	0.001814	0.095980	1	2	3	3	3	2	3	3	3
6.7	0.000454	0.096434	1	3	3	1	3	2	3	3	3
6.7	0.000076	0.096509	1	2	1	1	3	3	3	3	3
6.8	0.001254	0.097764	3	3	1	3	3	3	2	3	3
6.9	0.000227	0.097991	3	2	1	1	2	2	3	3	3
6.9	0.002722	0.100712	3	2	3	2	3	3	3	3	3
6.9	0.000057	0.100769	1	2	3	1	2	3	3	3	3
6.9	0.003629	0.104398	3	2	1	3	3	2	3	2	3
6.9	0.000907	0.105305	1	2	3	3	3	3	3	2	3
6.9	0.000389	0.105694	3	2	3	1	3	3	3	3	2
7.0	0.000941	0.106635	3	3	3	3	2	3	2	3	3
7.0	0.000101	0.106735	1	3	1	3	2	2	3	3	3
7.0	0.000691	0.107427	3	3	1	3	3	2	3	3	2
7.0	0.000907	0.108334	3	3	1	1	3	2	3	2	3
7.0	0.000227	0.108561	1	3	3	1	3	3	3	2	3
7.0	0.000173	0.108733	1	3	3	3	3	3	3	3	2
7.1	0.002722	0.111455	3	2	3	3	2	2	3	2	3
7.2	0.000518	0.111973	3	3	3	3	2	2	3	3	2
7.2	0.000680	0.112654	3	3	3	1	2	2	3	2	3
7.2	0.000113	0.112767	3	2	1	1	2	3	3	2	3
7.2	0.000086	0.112854	3	2	1	3	2	3	3	3	2
7.3	0.000050	0.112904	1	3	1	3	2	3	3	2	3
7.3	0.000346	0.113250	3	3	1	3	3	3	3	2	2
7.3	0.000022	0.113271	3	3	1	1	2	3	3	3	2
7.3	0.000151	0.113422	3	3	1	2	2	3	3	3	3
7.4	0.000605	0.114037	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

7.3	0.000151	0.113422	3	3	1	2	2	3	3	3	3
7.4	0.000605	0.114027	1	2	1	3	3	2	3	3	3
7.4	0.005645	0.119672	3	2	3	3	3	3	2	3	3
7.5	0.000259	0.119931	3	3	3	3	2	3	3	2	2
7.5	0.001411	0.121342	3	3	3	1	3	3	2	3	3
7.5	0.000151	0.121494	1	3	1	1	3	2	3	3	3
7.6	0.000454	0.121947	1	2	3	3	2	2	3	3	3
7.6	0.003110	0.125058	3	2	3	3	3	2	3	3	2
7.6	0.004082	0.129140	3	2	3	1	3	2	3	2	3
7.7	0.001814	0.130954	1	3	3	3	3	2	3	2	3
7.7	0.000778	0.131732	3	3	3	1	3	2	3	3	2
7.7	0.005443	0.137175	3	3	3	2	3	2	3	3	3
7.7	0.000113	0.137289	1	3	3	1	2	2	3	3	3
7.7	0.000130	0.137418	3	2	1	1	3	3	3	3	2
7.7	0.000302	0.137721	1	2	1	3	3	3	3	2	3
7.7	0.000907	0.138628	3	2	1	2	3	3	3	3	3
7.7	0.000019	0.138647	1	2	1	1	2	3	3	3	2
7.8	0.000058	0.138704	1	3	1	3	3	3	3	3	2
7.8	0.000076	0.138780	1	3	1	1	3	3	3	2	3
7.8	0.000314	0.139093	3	3	1	3	2	3	2	3	3
7.9	0.001555	0.140649	3	2	3	3	3	3	3	2	2
7.9	0.000097	0.140746	3	2	3	1	2	3	3	3	2
7.9	0.000680	0.141426	3	2	3	2	2	3	3	3	3
7.9	0.000907	0.142333	3	2	1	3	2	2	3	2	3
7.9	0.000227	0.142560	1	2	3	3	2	3	3	2	3
8.0	0.002722	0.145282	3	3	3	2	3	3	3	2	3
8.0	0.000227	0.145509	3	3	1	1	2	2	3	2	3
8.0	0.000173	0.145681	3	3	1	3	2	2	3	3	2
8.0	0.000057	0.145738	1	3	3	1	2	3	3	2	3
8.0	0.000043	0.145781	1	3	3	3	2	3	3	3	2
8.0	0.000389	0.146170	3	3	3	1	3	3	3	2	2
8.1	0.000680	0.146851	1	2	3	1	3	2	3	3	3
8.2	0.001882	0.148732	3	2	1	3	3	3	2	3	3
8.2	0.011290	0.160022	3	3	3	3	3	2	2	3	3
8.3	0.000086	0.160108	3	3	1	3	2	3	3	2	2
8.3	0.000470	0.160579	3	3	1	1	3	3	2	3	3
8.4	0.001411	0.161990	3	2	3	3	2	3	2	3	3
8.4	0.000259	0.162249	1	2	3	3	3	3	3	3	2
8.4	0.001037	0.163286	3	2	1	3	3	2	3	3	2
8.4	0.001361	0.164647	3	2	1	1	3	2	3	2	3
8.4	0.000151	0.164798	1	2	1	3	2	2	3	3	3
8.4	0.000340	0.165138	1	2	3	1	3	3	3	2	3
8.5	0.001814	0.166952	3	3	1	2	3	2	3	3	3
8.5	0.000605	0.167557	1	3	1	3	3	2	3	2	3
8.5	0.005645	0.173202	3	3	3	3	3	3	2	2	3
8.5	0.000353	0.173555	3	3	3	1	2	3	2	3	3
8.5	0.000454	0.174008	1	3	3	2	3	3	3	3	3
8.5	0.000038	0.174046	1	3	1	1	2	2	3	3	3
8.5	0.000259	0.174305	3	3	1	1	3	2	3	3	2
8.5	0.000065	0.174370	1	3	3	1	3	3	3	3	2
8.6	0.001021	0.175391	3	2	3	1	2	2	3	2	3
8.6	0.000778	0.176168	3	2	3	3	2	2	3	3	2
8.7	0.000076	0.176244	1	2	1	3	2	3	3	2	3
8.7	0.000518	0.176762	3	2	1	3	3	3	3	2	2
8.7	0.000032	0.176795	3	2	1	1	2	3	3	3	2
8.7	0.000227	0.177022	3	2	1	2	2	3	3	3	3
8.7	0.000194	0.177216	3	3	3	1	2	2	3	3	2
8.7	0.000454	0.177670	1	3	3	3	2	2	3	2	3
8.7	0.003110	0.180780	3	3	3	3	3	2	3	2	2
8.7	0.001361	0.182141	3	3	3	2	2	2	3	3	3
8.8	0.000130	0.182270	3	3	1	1	3	3	3	2	2
[illegible]	[illegible]	[illegible]	1	3	1	1	2	3	3	2	3

8.8	0.000130	0.182270	3	3	1	1	3	3	3	2	2
8.8	0.000019	0.182289	1	3	1	1	2	3	3	2	3
8.8	0.000014	0.182304	1	3	1	3	2	3	3	3	2
8.8	0.000907	0.183211	3	3	1	2	3	3	3	2	3
8.9	0.002117	0.185328	3	2	3	1	3	3	2	3	3
8.9	0.000389	0.185716	3	2	3	3	2	3	3	2	2
8.9	0.000227	0.185943	1	2	1	1	3	2	3	3	3
9.0	0.000680	0.186624	3	3	3	2	2	3	3	2	3
9.0	0.000941	0.187564	1	3	3	3	3	3	2	3	3
9.0	0.003763	0.191328	3	3	1	3	3	2	2	3	3
9.0	0.000097	0.191425	3	3	3	1	2	3	3	2	2
9.1	0.000170	0.191595	1	2	3	1	2	2	3	3	3
9.1	0.002722	0.194317	1	2	3	3	3	2	3	2	3
9.1	0.001166	0.195483	3	2	3	1	3	2	3	3	2
9.1	0.008165	0.203648	3	2	3	2	3	2	3	3	3
9.2	0.000470	0.204118	3	2	1	3	2	3	2	3	3
9.2	0.000086	0.204205	1	2	1	3	3	3	3	3	2
9.2	0.000518	0.204723	1	3	3	3	3	2	3	3	2
9.2	0.000680	0.205403	1	3	3	1	3	2	3	2	3
9.2	0.002822	0.208226	3	3	3	3	2	2	2	3	3
9.2	0.000113	0.208339	1	2	1	1	3	3	3	2	3
9.3	0.001882	0.210221	3	3	1	3	3	3	2	2	3
9.3	0.000022	0.210242	1	3	1	1	3	3	3	3	2
9.3	0.000151	0.210394	1	3	1	2	3	3	3	3	3
9.3	0.000118	0.210511	3	3	1	1	2	3	2	3	3
9.4	0.004382	0.214594	3	2	3	2	3	3	3	2	3
9.4	0.000340	0.214934	3	2	1	1	2	2	3	2	3
9.4	0.000259	0.215193	3	2	1	3	2	2	3	3	2
9.4	0.000085	0.215278	1	2	3	1	2	3	3	2	3
9.4	0.000065	0.215343	1	2	3	3	2	3	3	3	2
9.4	0.000583	0.215926	3	2	3	1	3	3	3	2	2
9.5	0.001037	0.216963	3	3	1	3	3	2	3	2	2
9.5	0.001411	0.218374	3	3	3	3	2	3	2	2	3
9.5	0.000065	0.218439	3	3	1	1	2	2	3	3	2
9.5	0.000016	0.218455	1	3	3	1	2	3	3	3	2
9.5	0.000778	0.219233	3	3	3	2	3	3	3	3	2
9.5	0.000113	0.219346	1	3	3	2	2	3	3	3	3
9.5	0.000151	0.219497	1	3	1	3	2	2	3	2	3
9.5	0.000454	0.219951	3	3	1	2	2	2	3	3	3
9.5	0.000259	0.220210	1	3	3	3	3	3	3	2	2
9.6	0.016934	0.237144	3	2	3	3	3	2	2	3	3
9.7	0.000130	0.237274	3	2	1	3	2	3	3	2	2
9.7	0.004234	0.241508	3	3	3	1	3	2	2	3	3
9.7	0.000706	0.242213	3	2	1	1	3	3	2	3	3
9.7	0.000778	0.242991	3	3	3	3	2	2	3	2	2
9.8	0.000314	0.243304	1	3	1	3	3	3	2	3	3
9.8	0.00003[illegible]	0.243337	3	3	1	1	2	3	3	2	2
9.8	0.000227	0.243564	3	3	1	2	2	3	3	2	3
9.9	0.000529	0.244093	3	2	3	1	2	3	2	3	3
9.9	0.000680	0.244773	1	2	3	2	3	3	3	3	3
9.9	0.000057	0.244830	1	2	1	1	2	2	3	3	3
9.9	0.000097	0.244927	1	2	3	1	3	3	3	3	2
9.9	0.000389	0.245316	3	2	1	1	3	2	3	3	2
9.9	0.000907	0.246223	1	2	1	3	3	2	3	2	3
9.9	0.008467	0.254690	3	2	3	3	3	3	2	2	3
9.9	0.002722	0.257412	3	2	1	2	3	2	3	3	3
10.0	0.001613	0.259025	3	3	3	3	3	3	2	3	2
10.0	0.002117	0.261141	3	3	3	1	3	3	2	2	3
10.0	0.000941	0.262082	3	3	1	3	2	2	2	3	3
10.0	0.000173	0.262255	1	3	1	3	3	2	3	3	2
20.1	0.000680	0.929091	1	2	3	3	2	2	2	2	2

10.0	0.000235	0.262490	1	3	3	3	2	3	2	3	3
10.0	0.000227	0.262717	1	3	1	1	3	2	3	2	3
10.1	0.004666	0.267383	3	2	3	3	3	2	3	2	2
10.1	0.000680	0.268063	1	2	3	3	2	2	3	2	3
10.1	0.002041	0.270104	3	2	3	2	2	2	3	3	3
10.1	0.000292	0.270396	3	2	3	1	2	2	3	3	2
10.2	0.000170	0.270566	1	3	3	1	2	2	3	2	3
10.2	0.000130	0.270696	1	3	3	3	2	2	3	3	2
10.2	0.000022	0.270717	1	2	1	3	2	3	3	3	2
10.2	0.000028	0.270745	1	2	1	1	2	3	3	2	3
10.2	0.008165	0.278910	3	3	3	2	3	2	3	2	3
10.2	0.000194	0.279105	3	2	1	1	3	3	3	2	2
10.2	0.001166	0.280271	3	3	3	1	3	2	3	2	2
10.2	0.001361	0.281632	3	2	1	2	3	3	3	2	3
10.3	0.000086	0.281718	1	3	1	3	3	3	3	2	2
10.3	0.000259	0.281977	3	3	1	2	3	3	3	3	2
10.3	0.000005	0.281983	1	3	1	1	2	3	3	3	2
10.3	0.000470	0.282453	3	3	1	3	2	3	2	2	3
10.3	0.000038	0.282491	1	3	1	2	2	3	3	3	3
10.4	0.005645	0.288136	3	2	1	3	3	2	2	3	3
10.4	0.000146	0.288282	3	2	3	1	2	3	3	2	2
10.4	0.001021	0.289302	3	2	3	2	2	3	3	2	3
10.4	0.001411	0.290713	1	2	3	3	3	3	2	3	3
10.5	0.000194	0.290908	3	3	3	2	2	3	3	3	2
10.5	0.001411	0.292319	3	3	1	1	3	2	2	3	3
10.5	0.000353	0.292672	1	3	3	1	3	3	2	3	3
10.5	0.000259	0.292931	3	3	1	3	2	2	3	2	2
10.5	0.000065	0.292996	1	3	3	3	2	3	3	2	2
10.6	0.004234	0.297229	3	2	3	3	2	2	2	3	3
10.6	0.001021	0.298250	1	2	3	1	3	2	3	2	3
10.6	0.000778	0.299028	1	2	3	3	3	2	3	3	2
10.7	0.000032	0.299060	1	2	1	1	3	3	3	3	2
10.7	0.002822	0.301882	3	2	1	3	3	3	2	2	3
10.7	0.000227	0.302109	1	2	1	2	3	3	3	3	3
10.7	0.016934	0.319044	3	3	3	3	3	2	2	2	3
10.7	0.000194	0.319238	1	3	3	1	3	2	3	3	2
10.7	0.000176	0.319414	3	2	1	1	2	3	2	3	3
10.7	0.001058	0.320473	3	3	3	1	2	2	2	3	3
10.7	0.001361	0.321834	1	3	3	2	3	2	3	3	3
10.8	0.000078	0.321912	1	3	1	3	2	3	2	3	3
10.8	0.000538	0.322450	3	3	1	3	3	3	2	3	2
10.8	0.000706	0.323155	3	3	1	1	3	3	2	2	3
10.9	0.002117	0.325272	3	2	3	3	2	3	2	2	3
10.9	0.000389	0.325661	1	2	3	3	3	3	3	2	2
10.9	0.001555	0.327216	3	2	1	3	3	2	3	2	2
10.9	0.000097	0.327313	3	2	1	1	2	2	3	3	2
10.9	0.000024	0.327338	1	2	3	1	2	3	3	3	2
10.9	0.001166	0.328504	3	2	3	2	3	3	3	3	2
10.9	0.000170	0.328674	1	2	3	2	2	3	3	3	3
10.9	0.000227	0.328901	1	2	1	3	2	2	3	2	3
10.9	0.000680	0.329581	3	2	1	2	2	2	3	3	3
11.0	0.000680	0.330262	1	3	3	2	3	3	3	2	3
11.0	0.000529	0.330791	3	3	3	1	2	3	2	2	3
11.0	0.000097	0.330888	1	3	3	1	3	3	3	2	2
11.0	0.000389	0.331277	3	3	1	1	3	2	3	2	2
11.0	0.000057	0.331334	1	3	1	1	2	2	3	2	3
11.0	0.000403	0.331737	3	3	3	3	2	3	2	3	2
11.0	0.000043	0.331780	1	3	1	3	2	2	3	3	2
11.0	0.002722	0.334502	3	3	1	2	3	2	3	2	3
11.1	0.001166	0.335668	3	2	3	3	2	2	3	2	2
11.1	0.006350	0.342018	3	2	3	1	3	2	2	3	3

11.1	0.006350	0.342018	3	2	3	1	3	2	2	3	3
11.2	0.000292	0.342310	3	3	3	1	2	2	3	2	2
11.2	0.002041	0.344351	3	3	3	2	2	2	3	2	3
11.2	0.000470	0.344822	1	2	1	3	3	3	2	3	3
11.2	0.002822	0.347544	1	3	3	3	3	2	2	3	3
11.2	0.000049	0.347693	3	2	1	1	2	3	3	2	2
11.2	0.000340	0.348033	3	2	1	2	2	3	3	2	3
11.3	0.000065	0.348098	3	3	1	2	2	3	3	3	2
11.3	0.000022	0.348119	1	3	1	3	2	3	3	2	2
11.3	0.000118	0.349237	1	3	1	1	3	3	2	3	3
11.4	0.003175	0.351412	3	2	3	1	3	3	2	2	3
11.4	0.000340	0.351752	1	2	1	1	3	2	3	2	3
11.4	0.002419	0.354171	3	2	3	3	3	3	2	3	2
11.4	0.000259	0.354431	1	2	1	3	3	2	3	3	2
11.4	0.000353	0.354783	1	2	3	3	2	3	2	3	3
11.4	0.001411	0.356195	3	2	1	3	2	2	2	3	3
11.5	0.005645	0.361839	3	3	1	3	3	2	2	2	3
11.5	0.000353	0.362192	3	3	1	1	2	2	2	3	3
11.5	0.001411	0.363603	1	3	3	3	3	3	2	2	3
11.5	0.000098	0.363692	1	3	3	1	2	3	2	3	3
11.5	0.000065	0.363756	1	3	1	1	3	2	3	3	2
11.5	0.000605	0.364361	3	3	3	1	3	3	2	3	2
11.5	0.004234	0.368595	3	3	3	2	3	3	2	3	3
11.5	0.000454	0.369048	1	3	1	2	3	2	3	3	3
11.6	0.012247	0.381296	3	2	3	2	3	2	3	[illegible]	3
11.6	0.000194	0.381490	1	2	3	3	2	2	3	3	2
11.6	0.000255	0.381745	1	2	3	1	2	2	3	2	3
11.6	0.001750	0.383495	3	2	3	1	3	2	3	2	2
11.7	0.000057	0.383551	1	2	1	2	2	3	3	3	3
11.7	0.000049	0.383600	1	3	3	1	2	2	3	3	2
11.7	0.000706	0.384306	3	2	1	3	2	3	2	2	3
11.7	0.000778	0.385083	1	3	3	3	3	2	3	2	2
11.7	0.004234	0.389317	3	3	3	3	2	2	2	2	3
11.7	0.000389	0.389706	3	2	1	2	3	3	3	3	2
11.7	0.000130	0.389835	1	2	1	3	3	3	3	2	2
11.7	0.000340	0.390175	1	3	3	2	2	2	3	3	3
11.7	0.002333	0.392508	3	3	3	2	3	2	3	3	2
11.7	0.000008	0.392516	1	2	1	1	2	3	3	3	2
11.8	0.000134	0.392651	3	3	1	3	2	3	2	3	2
11.8	0.000227	0.392870	1	3	1	2	3	3	3	2	3
11.8	0.000176	0.393054	3	3	1	1	2	3	2	2	3
11.8	0.000032	0.393086	1	3	1	1	3	3	3	2	2
11.9	0.002117	0.395203	3	2	1	1	3	2	2	3	3
11.9	0.000097	0.395300	1	2	3	3	2	3	3	2	2
11.9	0.000389	0.395689	3	2	1	3	2	2	3	2	2
11.9	0.000529	0.396218	1	2	3	1	3	3	2	3	3
11.9	0.000292	0.396510	3	2	3	2	2	3	3	3	2
12.0	0.001166	0.397676	3	3	3	2	3	3	3	2	2
12.0	0.000170	0.397846	1	3	3	2	2	3	3	2	3
12.0	0.000941	0.398787	1	3	1	3	3	2	2	3	3
12.0	0.000097	0.398884	3	3	1	1	2	2	3	2	2
12.0	0.000680	0.399565	3	3	1	2	2	2	3	2	3
12.0	0.000024	0.399589	1	3	3	1	2	3	3	2	2
12.1	0.025402	0.424991	3	2	3	3	3	2	2	2	3
12.1	0.001588	0.426578	3	2	3	1	2	2	2	3	3
12.1	0.000292	0.426870	1	2	3	1	3	2	3	3	2
12.1	0.002041	0.428911	1	2	3	2	3	2	3	3	3
12.2	0.006350	0.435262	3	3	3	1	3	2	2	2	3
12.2	0.000118	0.435379	1	2	1	3	2	3	2	3	3
12.2	0.000806	0.436186	3	2	1	3	3	3	2	3	2

12.2	0.001058	0.437244	3	2	1	1	3	3	2	2	3
12.2	0.000706	0.437950	1	3	3	3	2	2	2	3	3
12.2	0.004838	0.442788	3	3	3	3	3	2	2	3	2
12.3	0.000470	0.443258	1	3	1	3	3	3	2	2	3
12.3	0.000029	0.443288	1	3	1	1	2	3	2	3	3
12.3	0.000202	0.443489	3	3	1	1	3	3	2	3	2
12.3	0.001411	0.444901	3	3	1	2	3	3	2	3	3
12.4	0.000605	0.445505	3	2	3	3	2	3	2	3	2
12.4	0.000794	0.446299	3	2	3	1	2	3	2	2	3
12.4	0.001021	0.447320	1	2	3	2	3	3	3	2	3
12.4	0.000583	0.447903	3	2	1	1	3	2	3	2	2
12.4	0.000146	0.448049	1	2	3	1	3	3	3	2	2
12.4	0.000085	0.448134	1	2	1	1	2	2	3	2	3
12.4	0.004082	0.452216	[illegible]	2	1	2	3	2	3	2	3
12.4	0.000065	0.452281	1	2	1	3	2	2	3	3	2
12.5	0.000259	0.452540	1	3	1	3	3	2	3	2	2
12.5	0.002419	0.454959	3	3	3	3	3	3	2	2	2
12.5	0.001058	0.456018	3	3	3	2	2	3	2	3	3
12.5	0.000151	0.456169	3	3	3	1	2	3	2	3	2
12.5	0.000353	0.456522	1	3	3	3	2	3	2	2	3
12.5	0.000194	0.456716	1	3	3	2	3	3	3	3	2
12.5	0.000016	0.456732	1	3	1	1	2	2	3	3	2
12.5	0.000778	0.457510	3	3	1	[illegible]	3	[illegible]	3	3	2
12.5	0.001411	0.458921	3	3	1	3	2	2	2	2	3
12.5	0.000113	0.459035	1	3	1	[illegible]	[illegible]	2	3	3	3
12.6	0.034234	0.463268	1	2	3	3	3	[illegible]	2	3	3
12.6	0.000437	0.463705	3	2	3	1	2	2	3	2	2
12.6	0.003062	0.465767	3	2	3	2	2	2	3	2	3
12.7	0.000583	0.467351	3	3	3	2	2	2	3	3	2
12.7	0.000032	0.467383	1	2	1	3	2	3	3	2	2
12.7	0.000097	0.467480	3	2	1	2	2	3	3	3	2
12.7	0.001058	0.468539	1	3	3	1	3	2	2	3	3
12.7	0.000176	0.468715	1	2	1	1	3	3	2	3	3
12.7	0.000194	0.468909	1	3	3	3	2	2	3	2	2
12.8	0.000008	0.468917	1	3	1	1	2	3	3	2	2
12.8	0.000389	0.469306	3	3	1	2	3	3	3	2	2
12.8	0.000057	0.469363	1	3	1	2	2	3	3	2	3
12.9	0.000907	0.470270	3	2	3	1	3	3	2	3	2
12.9	0.002117	0.472387	1	2	3	3	3	3	2	2	3
12.9	0.008467	0.480854	3	2	1	3	3	2	2	2	3
12.9	0.006350	0.487205	3	2	3	2	3	3	2	3	3
12.9	0.000529	0.487734	3	2	1	1	2	2	2	3	3
12.9	0.000680	0.488414	1	2	1	2	3	2	3	3	3
12.9	0.000097	0.488511	1	2	1	1	3	2	3	3	2
12.9	0.000132	0.488644	1	2	3	1	2	3	2	3	3
13.0	0.001613	0.490256	3	3	1	3	3	2	2	3	2
13.0	0.002117	0.492373	3	3	1	1	3	2	2	2	3
13.0	0.000292	0.492665	3	3	3	2	2	3	3	2	2
13.0	0.000403	0.493068	1	3	3	3	3	3	2	3	2
13.0	0.000529	0.493597	1	3	3	1	3	3	2	2	3
13.0	0.000235	0.493832	1	3	1	3	2	2	2	3	3
13.1	0.000073	0.493905	1	2	3	1	2	2	3	3	2
13.1	0.006350	0.500256	3	2	3	3	2	2	2	2	3
13.1	0.003499	0.503755	3	2	3	2	3	2	3	3	2
13.1	0.001166	0.504921	1	2	3	3	3	2	3	2	2
13.1	0.000510	0.505432	1	2	3	2	2	2	3	3	3
13.2	0.000292	0.505723	1	3	3	1	3	2	3	2	2
13.2	0.000265	0.505988	3	2	1	1	2	3	2	2	3
13.2	0.002041	0.508029	1	3	3	2	3	2	3	2	3
13.2	0.001588	0.509617	3	3	3	1	2	2	2	2	3
13.2	0.001210	0.510826	3	3	3	3	2	2	2	3	2
[illegible]	[illegible]	0.511028	3	2	1	3	2	3	2	3	2

13.2	0.001210	0.510826	3	3	3	3	2	2	2	3	2
13.2	0.000202	0.511028	3	2	[illegible]	3	2	3	2	3	2
13.2	0.000740	0.511358	1	2	1	2	3	3	3	2	3
13.2	0.000049	0.511417	1	2	1	1	3	3	3	2	2
13.3	0.000118	0.511534	[illegible]	3	1	3	2	3	2	2	3
13.3	0.000806	0.512341	3	3	[illegible]	3	3	3	2	2	2
13.3	0.000353	0.512693	3	3	1	2	2	3	2	3	3
13.3	0.000050	0.512744	3	3	1	1	2	3	2	3	2
13.3	0.000065	0.512809	1	3	1	2	3	3	3	3	2
13.4	0.00[illegible]	0.514558	3	2	3	2	3	3	3	2	2
13.4	0.000255	0.514813	1	2	3	2	2	3	3	2	3
13.4	0.001411	0.516225	1	2	1	3	3	2	2	3	3
13.4	0.000146	0.516370	3	2	1	[illegible]	2	2	3	2	2
13.4	0.001021	0.517391	3	2	[illegible]	2	2	2	3	2	3
13.4	0.000036	0.517427	1	2	3	1	2	3	3	2	2
13.5	0.000065	0.517492	1	3	1	3	2	2	3	2	2
13.5	0.000353	0.517845	1	3	1	1	3	2	2	3	3
13.5	0.000605	0.518450	3	3	3	3	2	3	2	2	2
13.5	0.000049	0.518499	1	3	3	2	2	3	3	3	2
13.5	0.000194	0.518693	3	3	1	2	2	2	3	3	[illegible]
13.5	0.007258	0.525950	3	2	3	3	3	2	2	3	2
13.6	0.009525	0.535476	3	2	3	1	3	2	2	2	3
13.6	0.001058	0.536534	1	2	3	3	2	2	2	3	3
13.7	0.002117	0.538651	3	2	1	2	3	3	2	3	3
13.7	0.012701	0.551352	3	3	3	2	3	2	2	3	3
13.7	0.001814	0.553166	3	3	3	1	3	2	2	3	2
13.7	0.004234	0.557400	1	3	3	3	3	2	2	2	3
13.7	0.000706	0.558106	1	2	1	3	3	3	2	2	3
13.7	0.000302	0.558408	3	2	1	1	3		2	3	2
13.7	0.000044	0.558452	1	2	1	1	2	3	2	3	3
13.7	0.000265	0.558717	1	[illegible]	3	1	2	2	2	3	3
13.8	0.000097	0.558814	3	3	1	2	2	3	3	2	2
13.8	0.000176	0.558990	1	3		1	3	3	2	2	3
13.8	0.000134	0.[illegible]125	1	3	1	3	3	3	2	3	2
13.9	0.000227	[illegible]352	3	2	3	1	2	3	2	3	2
13.9	0.00038[illegible]	.559740	1	2	1	3	3	2	3	2	2
13.9	0.000[illegible]	0.560032	1	2	3	2	3	3	3	[illegible]	2
13.9	0.0036[illegible]	0.563561	3	2	3	3	3	3	2	2	2
13.9	0.0015[illegible]	0.565248	3	2	3	2	2	3	2	3	3
13.9	0.000170	0.565418	1	2	1	2	2	2	3	3	3
13.9	0.000529	0.565948	1	2	3	3	2	3	2	2	3
13.9	0.000024	0.565972	1	2	1	1	2	2	3	3	2
13.9	0.002117	0.568089	3	2	1	3	2	2	2	2	3
13.9	0.001163	0.569255	3	2	1	2	3	2	3	3	2
14.0	0.000132	0.569387	1	3	3	1	2	3	2	2	3
14.0	0.[illegible]03403	0.569791	3	3	1	3	2	2	2	3	2
14.0	0.000097	0.569888	1	3	1	1	3	2	3	2	2
14.0	0.000529	0.570417	3	3	1	1	2	2	2	2	3
14.0	0.00[illegible]7	0.571324	3	3	3	1	3	3	2	2	2
14.0	0.000101	0.571425	1	3	3	3	2	3	2	3	2
14.0	0.006350	0.577775	3	3	3	2	3	3	2	2	3
14.0	0.000680	0.578456	1	3	1	2	3	2	3	2	3
14.1	0.000875	0.579331	3	2	3	2	2	2	3	3	2
14.1	0.001588	0.580918	1	2	3	1	[illegible]	2	2	3	3
14.1	0.000292	0.581210	1	2	[illegible]	3	[illegible]	2	3	2	2
14.2	0.000012	0.581222	1	2	[illegible]	1	2	3	3	2	2
14.2	0.000583	0.581805	3	2	[illegible]	2	3	3	3	2	2
14.2	0.003499	0.585304	3	3	[illegible]	2	3	2	3	2	2
14.2	0.000085	0.585389	1	2	1	2	2	3	3	2	3
14.2	0.000510	0.585900	1	3	3	2	2	2	3	2	3

20.1	0.000680	0.929091	1	2	3	3	2	2	2	2	2

14.2	0.000073	0.585973	1	3	3	1	2	2	3	2	2
14.3	0.000202	0.586174	3	3	1	3	2	3	2	2	2
14.3	0.000016	0.586190	1	3	1	2	2	3	3	3	2
14.4	0.000794	0.586984	1	2	3	1	3	3	2	2	3
14.4	0.002419	0.589403	3	2	1	3	3	2	2	3	2
14.4	0.003175	0.592579	3	2	1	1	3	2	2	2	3
14.4	0.000437	0.593016	3	2	3	2	2	3	3	2	2
14.4	0.000353	0.593369	1	2	1	3	2	2	2	3	3
14.4	0.000605	0.593974	1	2	3	3	3	3	2	3	2
14.5	0.001411	0.595385	1	3	1	3	3	2	2	2	3
14.5	0.000088	0.595473	1	3	1	1	2	2	2	3	3
14.5	0.000151	0.595624	1	3	3	1	3	3	2	3	2
14.5	0.000605	0.596229	3	3	1	1	3	2	2	3	2
14.5	0.004234	0.600463	3	3	1	2	3	2	2	3	3
14.5	0.001058	0.601521	1	3	3	2	3	3	2	3	3
14.6	0.000381	0.603902	3	2	3	1	2	2	2	2	3
14.6	0.001814	0.605717	3	2	3	3	2	2	2	3	2
14.6	0.000437	0.606154	1	2	3	1	3	2	3	2	2
14.6	0.003062	0.609216	1	2	3	2	3	2	3	2	3
14.7	0.001058	0.610274	1	3	3	3	2	2	2	2	3
14.7	0.000454	0.610728	3	3	3	1	2	2	2	3	2
14.7	0.001210	0.611938	3	2	1	3	3	3	2	2	2
14.7	0.000583	0.612521	1	3	3	2	3	2	3	3	2
14.7	0.007258	0.619778	3	3	3	3	3	2	2	2	2
14.7	0.000098	0.619876	1	2	1	2	3	3	3	3	2
14.7	0.003175	0.623051	3	3	3	2	2	2	2	3	3
14.7	0.000176	0.623227	1	2	1	3	2	3	2	2	3
14.7	0.000076	0.623303	3	2	1	1	2	3	2	3	2
14.7	0.000529	0.623932	3	2	1	2	2	3	2	3	3
14.8	0.002117	0.625949	3	3	1	2	3	3	2	2	3
14.8	0.000044	0.625993	1	3	1	1	2	3	2	2	3
14.9	0.000302	0.626295	3	3	1	1	3	3	2	2	2
14.9	0.000034	0.626329	1	3	1	3	2	3	2	3	2
14.9	0.000907	0.627236	3	2	3	3	2	3	2	2	2
14.9	0.000529	0.627765	1	2	1	1	3	2	2	3	3
14.9	0.000073	0.627838	1	2	3	2	2	3	3	3	2
14.9	0.000292	0.628130	3	2	1	2	2	2	3	3	2
14.9	0.000097	0.628227	1	2	1	3	2	2	3	2	2
15.0	0.000292	0.628519	1	3	3	2	3	3	3	2	2
15.0	0.001166	0.629685	3	3	1	2	3	2	3	2	2
15.0	0.001588	0.631273	3	3	3	2	2	3	2	2	3
15.0	0.000024	0.631297	1	3	1	1	2	2	3	2	2
15.0	0.000227	0.631524	3	3	3	1	2	3	2	2	2
15.0	0.000170	0.631694	1	3	1	2	2	2	3	2	3
15.1	0.006350	0.638044	1	2	3	3	3	2	2	2	3
15.1	0.000397	0.638441	1	2	3	1	2	2	2	3	3
15.1	0.019051	0.657492	3	2	3	2	3	2	2	3	3
15.1	0.002722	0.660214	3	2	3	1	3	2	2	3	2
15.2	0.000146	0.660360	3	2	1	2	2	3	3	2	2
15.2	0.000202	0.660561	1	2	1	3	3	3	2	3	2
15.2	0.000875	0.661436	3	3	3	2	2	2	3	2	2
15.2	0.001588	0.663024	1	3	3	1	3	2	2	2	3
15.2	0.001210	0.664233	1	3	3	3	3	2	2	3	2
15.2	0.000265	0.664498	1	2	1	1	3	3	2	2	3
15.3	0.000353	0.664851	1	3	1	2	3	3	2	3	3
15.3	0.000050	0.664901	1	3	1	1	3	3	2	3	2
15.4	0.001361	0.666262	3	2	3	1	3	3	2	2	2
15.4	0.009526	0.675788	3	2	3	2	3	3	2	2	3
15.4	0.000146	0.675933	1	2	1	1	3	2	3	2	2
15.4	0.000794	0.676727	3	2	1	1	2	2	2	2	3

15.4	0.000198	0.676926	1	2	3	1	2	3	2	2	3

15.4	0.000198	0.676926	1	2	3	1	2	3	2	2	3
15.4	0.001021	0.677946	1	2	1	2	3	2	3	2	3
15.4	0.000605	0.678551	3	2	1	3	2	2	2	3	2
15.4	0.000151	0.678702	1	2	3	3	2	3	2	3	2
15.5	0.000353	0.679055	1	3	1	3	2	2	2	2	3
15.5	0.000151	0.679206	3	3	1	1	2	2	2	3	2
15.5	0.000605	0.679811	1	3	3	3	3	3	2	2	2
15.5	0.001814	0.681625	3	3	3	2	3	3	2	3	2
15.5	0.002419	0.684045	3	3	1	3	3	2	2	2	2
15.5	0.000038	0.6840[illegible]	1	3	[illegible]	1	2	3	2	3	2
15.5	0.001058	0.685[illegible]	3	3	1	2	2	2	2	3	3
15.5	0.000265	0.685[illegible]	1	3	3	2	2	3	2	3	3
15.5	0.000194	[illegible]	1	3	1	2	3	2	3	3	2
15.6	0.0052[illegible]	[illegible]9	3	2	3	2	3	2	3	2	2
15.[illegible]	[illegible]	0.690958	1	2	3	1	2	2	3	2	2
[illegible]	[illegible]	0.691723	1	2	3	2	2	2	3	2	3
[illegible]	[illegible]	0.693538	3	3	3	3	2	2	2	2	2
[illegible]	[illegible]0146	0.693684	1	3	[illegible]	2	2	2	3	3	2
15.[illegible]	0.000302	0.693986	3	2	1	3	2	3	2	2	2
15.[illegible]	0.0000[illegible]	0.694010	1	2	1	2	2	3	3	3	2
15.[illegible]	0.000097	0.694108	1	3	1	2	3	3	3	2	2
15.8	0.000076	0.694183	3	3	1	1	2	3	2	2	2
15.8	0.000529	0.694712	3	3	1	2	2	3	2	2	3
15.9	0.00211[illegible]	0.696829	1	2	1	3	3	2	2	2	3
15.9	0.000132	0.696961	1	2	1	1	2	2	2	3	3
15.9	0.000227	0.697188	1	2	3	1	3	3	2	3	2
15.9	0.001588	0.698776	1	2	3	2	3	3	2	3	3
15.9	0.000907	0.699683	3	2	1	1	3	2	2	3	2
15.9	0.005350	0.706033	3	2	1	2	3	2	2	3	3
16.0	0.000073	0.706106	1	3	3	2	2	3	3	2	2
16.0	0.000403	0.706510	1	3	1	3	3	2	2	3	2
16.0	0.000529	0.707039	1	3	1	1	3	2	2	2	3
16.0	0.000292	0.707330	3	3	1	2	2	2	3	2	2
16.1	0.000875	0.708205	1	2	3	2	3	2	3	3	2
16.1	0.010886	0.719092	3	2	3	3	3	2	2	2	2
16.1	0.000680	0.719772	3	2	3	1	2	2	2	3	2
16.1	0.004763	0.724535	3	2	3	2	2	2	2	3	3
16.1	0.001588	0.726122	1	2	3	3	2	2	2	2	3
16.2	0.003175	0.7292[illegible]	3	2	1	2	3	3	2	2	3
16.2	0.000454	0.729751	3	2	1	1	3	3	2	2	2
16.2	0.000302	0.730054	1	[illegible]	3	3	2	2	2	3	2
16.2	0.019051	0.749105	3	[illegible]	3	2	3	2	2	2	3
16.2	0.000050	0.749155	1	[illegible]	1	3	2	3	2	3	2
16.2	0.002722	0.751877	3	3	3	1	3	2	2	2	2
16.2	0.000066	0.751943	1	[illegible]	1	1	2	3	2	2	3
16.2	0.000397	0.752340	1	3	3	1	2	2	2	2	3
16.3	0.000605	0.752945	3	3	1	2	3	3	2	3	2
16.3	0.000202	0.753146	1	3	1	3	3	3	2	2	2
16.3	0.000088	0.753234	1	3	1	2	2	3	2	3	3
16.3	0.000013	0.753247	1	3	1	1	2	3	2	3	2
16.4	0.000255	0.753502	1	2	1	2	2	2	3	2	3
16.4	0.000340	0.753842	3	2	3	1	2	3	2	2	2
16.4	0.000437	0.754280	1	2	3	2	3	3	3	2	2
16.4	0.002381	0.756661	3	2	3	2	2	3	2	2	3
16.4	0.001750	0.758411	3	2	1	2	3	2	3	2	2
16.4	0.000036	0.758447	1	2	1	1	2	2	3	2	2
16.5	0.000454	0.758901	3	3	3	2	2	3	2	3	2
16.5	0.000151	0.759052	1	3	3	3	2	3	2	2	2
16.5	0.000605	0.759657	3	3	1	3	2	2	2	2	2
16.5	0.000049	0.759705	1	3	1	2	2	2	3	3	2
20.1	0.000680	0.929091	1	2	3	3	2	2	2	2	2

16.6	0.001312	0.751018	3	2	3	2	2	2	3	2	2
16.6	0.002381	0.763399	1	2	3	1	3	2	2	2	3
16.6	0.001814	0.765213	1	2	3	3	3	2	2	3	2
16.7	0.003175	0.768389	1	3	3	2	3	2	2	3	3
16.7	0.000454	0.768842	1	3	3	1	3	2	2	3	2
16.7	0.000076	0.768918	1	2	1	1	3	3	2	3	2
16.7	0.000529	0.769447	1	2	1	2	3	3	2	3	3
16.8	0.000024	0.769471	1	3	1	2	2	3	3	2	2
16.9	0.001588	0.771059	3	2	1	2	2	2	2	3	3
16.9	0.000907	0.771966	1	2	3	3	3	3	2	2	2
16.9	0.000397	0.772363	1	2	3	2	2	3	2	3	3
16.9	0.000227	0.772590	3	2	1	1	2	2	2	3	2
16.9	0.000057	0.772647	1	2	3	1	2	3	2	3	2
16.9	0.000529	0.773176	1	2	1	3	2	2	2	2	3
16.9	0.002722	0.775897	3	2	3	2	3	3	2	3	2
16.9	0.000292	0.776189	1	2	1	2	3	2	3	3	2
16.9	0.003629	0.779818	3	2	1	3	3	2	2	2	2
17.0	0.001588	0.781405	1	3	3	2	3	3	2	2	3
17.0	0.000132	0.781538	1	3	1	1	2	2	2	2	3
17.0	0.000227	0.781764	1	3	3	1	3	3	2	2	2
17.0	0.000907	0.782672	3	3	1	1	3	2	2	2	2
17.0	0.000101	0.782772	1	3	1	3	2	2	2	3	2
17.0	0.006350	0.789123	3	3	1	2	3	2	2	2	3
17.1	0.000219	0.789341	1	2	3	2	2	2	3	3	2
17.1	0.002722	0.792063	3	2	3	3	1	2	2	2	2
17.2	0.000680	0.792743	3	3	3	1	2	2	2	2	2
17.2	0.000794	0.793537	3	2	1	2	2	3	2	2	3
17.2	0.004763	0.798300	3	3	3	2	2	2	2	2	3
17.2	0.000113	0.798413	3	2	1	1	2	3	2	2	2
17.2	0.000146	0.798559	1	2	1	2	3	3	3	2	2
17.2	0.000875	0.799434	1	3	3	2	3	2	3	2	2
17.3	0.000050	0.799484	1	3	1	3	2	3	2	2	2
17.3	0.000151	0.799636	3	3	1	2	2	3	2	3	2
17.4	0.000109	0.799745	1	2	3	2	2	3	3	2	2
17.4	0.000437	0.800182	3	2	1	2	2	2	3	2	2
17.4	0.000605	0.800787	1	2	1	3	3	2	2	3	2
17.4	0.000794	0.801581	1	2	1	1	3	2	2	2	3
17.5	0.000151	0.801732	1	3	1	1	3	2	2	3	2
17.5	0.001058	0.802791	1	3	1	2	3	2	2	3	3
17.6	0.000454	0.803244	1	2	3	3	2	2	2	3	2
17.6	0.028577	0.831821	3	2	3	2	3	2	2	2	3
17.6	0.004082	0.835903	3	2	3	1	3	2	2	2	2
17.6	0.000595	0.836499	1	2	3	1	2	2	2	2	3
17.7	0.000302	0.836801	1	2	1	3	3	3	2	2	2
17.7	0.001814	0.838616	1	3	3	3	3	2	2	2	2
17.7	0.000794	0.839409	1	3	3	2	2	2	2	3	3
17.7	0.005443	0.844853	3	3	3	2	3	2	2	3	2
17.7	0.000113	0.844966	1	3	3	1	2	2	2	3	2
17.7	0.000907	0.845873	3	2	1	2	3	3	2	3	2
17.7	0.000132	0.846005	1	2	1	2	2	3	2	3	3
17.7	0.000019	0.846024	1	2	1	1	2	3	2	3	2
17.8	0.000529	0.846554	1	3	1	2	3	3	2	2	3
17.8	0.000076	0.846629	1	3	1	1	3	3	2	2	2
17.9	0.000227	0.846856	1	2	3	3	2	3	2	2	2
17.9	0.000073	0.846929	1	2	1	2	2	2	3	3	2
17.9	0.000680	0.847609	3	2	3	2	2	3	2	3	2
17.9	0.000907	0.848516	3	2	1	3	2	2	2	2	2
18.0	0.002722	0.851238	3	3	3	2	3	3	2	2	2
18.0	0.000227	0.851465	3	3	1	1	2	2	2	2	2
18.0	0.000057	0.851522	1	3	3	1	2	3	2	2	[illegible]
18.0	0.001588	0.853109	3	3	1	2	2	2	2	2	3
18.0	0.000397	0.853506	1	3	3	[illegible]	[illegible]	3	[illegible]	[illegible]	3

18.0	0.001589	0.853109	3	3	1	2	2	2	2	2	3
18.0	0.000397	0.853506	1	3	3	2	2	3	2	2	3
18.0	0.000292	0.853798	1	3	1	2	3	2	3	2	2
18.1	0.000680	0.854478	1	2	3	1	3	2	2	3	2
18.1	0.004763	0.859241	1	2	3	2	3	2	2	3	3
18.2	0.000036	0.859277	1	2	1	2	2	3	3	2	2
18.2	0.000219	0.859496	1	3	3	2	2	2	3	2	2
18.4	0.000340	0.859836	1	2	3	1	3	3	2	2	2
18.4	0.001361	0.861197	3	2	1	1	3	2	2	2	2
18.4	0.000151	0.861348	1	2	1	3	2	2	2	3	2
18.4	0.009526	0.870874	3	2	1	2	3	2	2	2	3
18.4	0.002381	0.873255	1	2	3	2	3	3	2	2	3
18.4	0.000198	0.873454	1	2	1	1	2	2	2	2	3
18.5	0.000454	0.873907	1	3	3	2	3	3	2	3	2
18.5	0.000038	0.873945	1	3	1	1	2	2	2	3	2
18.5	0.000605	0.874550	1	3	1	3	3	2	2	2	2
18.5	0.001814	0.876364	3	3	1	2	3	2	2	3	2
18.5	0.000265	0.876629	1	3	1	2	2	2	2	3	3
18.6	0.001021	0.877649	3	2	3	1	2	2	2	2	2
18.6	0.001312	0.878962	1	2	3	2	3	2	3	2	2
18.6	0.007144	0.886106	3	2	3	2	2	2	2	2	3
18.7	0.001361	0.887467	3	3	3	2	2	2	2	3	2
18.7	0.000076	0.887542	1	2	1	3	2	3	2	2	2
18.7	0.000454	0.887996	1	3	3	3	2	2	2	2	2
18.7	0.000227	0.888223	3	2	1	2	2	3	2	3	2
18.8	0.000019	0.888242	1	3	1	1	2	3	2	2	2
18.8	0.000132	0.888374	1	3	1	2	2	3	2	2	3
18.8	0.000907	0.889281	3	3	1	2	3	3	2	2	2
18.9	0.001588	0.890869	1	2	1	2	3	2	2	3	3
18.9	0.000227	0.891096	1	2	1	1	3	2	2	3	2
19.0	0.000680	0.891776	3	3	3	2	2	3	2	2	2
19.0	0.000073	0.891849	1	3	1	2	2	2	3	2	2
19.1	0.001191	0.893040	1	2	3	2	2	2	2	3	3
19.1	0.008165	0.901204	3	2	3	2	3	2	2	3	2
19.1	0.002722	0.903926	1	2	3	3	3	2	2	2	2
19.1	0.000170	0.904096	1	2	3	1	2	2	2	3	2
19.2	0.000794	0.904890	1	2	1	2	3	3	2	2	3
19.2	0.000113	0.905003	1	2	1	1	3	3	2	2	2
19.2	0.004763	0.909766	1	3	3	2	3	2	2	2	3
19.2	0.000680	0.910446	1	3	3	1	3	2	2	2	2
19.3	0.000151	0.910598	1	3	1	2	3	3	2	3	2
19.4	0.000437	0.911035	1	2	1	2	3	2	3	2	2
19.4	0.000085	0.911120	1	2	3	1	2	3	2	2	2
19.4	0.004082	0.915202	3	2	3	2	3	3	2	2	2
19.4	0.002381	0.917584	3	2	1	2	2	2	2	2	3
19.4	0.000340	0.917924	3	2	1	1	2	2	2	2	2
19.4	0.000595	0.918519	1	2	3	2	2	3	2	2	3
19.5	0.000113	0.918633	1	3	3	2	2	3	2	3	2
19.5	0.000151	0.918784	1	3	1	3	2	2	2	2	2
19.5	0.000454	0.919238	3	3	1	2	2	2	2	3	2
19.6	0.000328	0.919566	1	2	3	2	2	2	3	2	2
19.8	0.000227	0.919792	3	3	1	2	2	3	2	2	2
19.9	0.002722	0.922514	3	2	1	2	3	2	2	3	2
19.9	0.000680	0.923194	1	2	3	2	3	3	2	3	2
19.9	0.000907	0.924102	1	2	1	3	3	2	2	2	2
19.9	0.000057	0.924158	1	2	1	1	2	2	2	3	2
19.9	0.000397	0.924555	1	2	1	2	2	2	2	3	3
20.0	0.000227	0.924782	1	3	1	1	3	2	2	2	2
20.0	0.001588	0.926370	1	3	1	2	3	2	2	2	3
20.1	0.002041	0.928411	3	2	3	2	2	2	2	3	2
20.1	0.000680	[illegible]	1	2	3	3	2	2	2	2	2
20.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

20.1	0.000680	0.929091	1	2	3	3	2	2	2	2	2
20.2	0.008165	0.937256	3	3	3	2	3	2	2	2	2
20.2	0.000028	0.937284	1	2	1	1	2	3	2	2	2
20.2	0.001361	0.938645	3	2	1	2	3	3	2	2	2
20.2	0.000170	0.938815	1	3	3	1	2	2	2	2	2
20.2	0.000198	0.939014	1	2	1	2	2	3	2	2	3
20.2	0.001191	0.940204	1	3	3	2	2	2	2	2	3
20.3	0.000039	0.940242	1	3	1	2	2	3	2	3	2
20.4	0.001021	0.941263	3	2	3	2	2	3	2	2	2
20.4	0.000109	0.941372	1	2	1	2	2	2	3	2	2
20.6	0.007144	0.948516	1	2	3	2	3	2	2	2	3
20.6	0.001021	0.949537	1	2	3	1	3	2	2	2	2
20.7	0.001361	0.950898	1	3	3	2	3	2	2	3	2
20.7	0.000227	0.951125	1	2	1	2	3	3	2	3	2
20.9	0.000227	0.951351	1	2	1	3	2	2	2	2	2
20.9	0.000170	0.951521	1	2	3	2	2	3	2	3	2
20.9	0.000680	0.952202	3	2	1	2	2	2	2	3	2
21.0	0.000057	0.952259	1	3	1	1	2	2	2	2	2
21.0	0.002722	0.954980	3	3	1	2	3	2	2	2	2
21.0	0.000680	0.955661	1	3	3	2	3	3	2	2	2
21.0	0.000397	0.956058	1	3	1	2	2	2	2	2	3
21.2	0.002041	0.958099	3	3	3	2	2	2	2	2	2
21.2	0.000340	0.958439	3	2	1	2	2	3	2	2	2
21.4	0.002381	0.960820	1	2	1	2	3	2	2	2	3
21.4	0.000340	0.961160	1	2	1	1	3	2	2	2	2
21.5	0.000454	0.961614	1	3	1	2	3	2	2	3	2
21.6	0.000255	0.961869	1	2	3	1	2	2	2	2	2
21.6	0.012247	0.974116	3	2	3	2	3	2	2	2	2
21.6	0.001786	0.975903	1	2	3	2	2	2	2	2	3
21.7	0.000340	0.976243	1	3	3	2	2	2	2	3	2
21.7	0.000057	0.976299	1	2	1	2	2	3	2	3	2
21.8	0.000227	0.976526	1	3	1	2	3	3	2	2	2
22.0	0.000680	0.977207	3	3	1	2	2	2	2	2	2
22.0	0.000170	0.977377	1	3	3	2	2	3	2	2	2
22.1	0.002041	0.979418	1	2	3	2	3	2	2	3	2
22.4	0.000085	0.979503	1	2	1	1	2	2	2	2	2
22.4	0.004082	0.983585	3	2	1	2	3	2	2	2	2
22.4	0.001021	0.984606	1	2	3	2	3	3	2	2	2
22.4	0.000595	0.985201	1	2	1	2	2	2	2	2	3
22.5	0.000113	0.985315	1	3	1	2	2	2	2	3	2
22.6	0.003062	0.988377	3	2	3	2	2	2	2	2	2
22.8	0.000057	0.988433	1	3	1	2	2	3	2	2	2
22.9	0.000680	0.989114	1	2	1	2	3	2	2	3	2
23.1	0.000510	0.989624	1	2	3	2	2	2	2	3	2
23.2	0.000340	0.989964	1	2	1	2	3	3	2	2	2
23.2	0.002041	0.992005	1	3	3	2	3	2	2	2	2
23.4	0.001021	0.993026	3	2	1	2	2	2	2	2	2
23.4	0.000255	0.993281	1	2	3	2	2	3	2	2	2
23.9	0.000170	0.993451	1	2	1	2	2	2	2	3	2
24.0	0.000680	0.994132	1	3	1	2	3	2	2	2	2
24.2	0.000510	0.994642	1	3	3	2	2	2	2	2	2
24.2	0.000085	0.994727	1	2	1	2	2	3	2	2	2
24.6	0.003062	0.997789	1	2	3	2	3	2	2	2	2
25.0	0.000170	0.997959	1	3	1	2	2	2	2	2	2
25.4	0.001021	0.998979	1	2	1	2	3	2	2	2	2
25.6	0.000765	0.999745	1	2	3	2	2	2	2	2	2
26.4	0.000255	1.000000	1	2	1	2	2	2	2	2	2

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